No. $\frac{4612}{7}$.

SUBJECT:

Report on the Nagpur Experimental Farm for the year 1893-94.

FROM

R. H. CRADDOCK, ESQ., I. C. S.

OFFG. COMMR. OF SETTLEMENTS AND AGRICULTURE,

Central Provinces,

To

THE SECOND SECY. TO THE CHIEF COMMR.,

REVENUE DEPARTMENT,

Central Provinces.

Dated Nagpur, the 4th December 1894.

SIR,

I have the honour to submit the Annual Report on the Nagpur Experimental Farm for the year ending March 31st 1894.

2. As was noticed in last year's report, the scheme of experiments has been so shaped as to give continuous results over the same plots of the same experiments over a series of years. This scheme has been carried on during the year now under report, and we have now four years' results for the most important experiments of the regular or A series. Some few experiments have a longer history. But the teachings to be derived from them are frequently vitiated by the effect of adverse seasons. In particular attacks of rust frequently obscure the results of the most careful experiments, and the linseed is now annually almost destroyed over many plots by the disease locally known as 'talap', caused probably by some parasitic plant which consumes the whole nourishment of the young crop and causes it to wither away long before it has attained its full growth. The investigation of the disease of 'talap', which is well known to the cultivators of these Provinces, is a matter of much importance. As things are now, it will, before long, be useless to attempt experiments with linseed on the Farm. Another fact which has to be allowed for is that the site of the Farm, although the best that could be procured at Nagpur itself, regard being paid to the possibility of effective supervision, is by no means good in itself. The Farm lands lie in an area and situation undoubtedly too moist for the successful growth of cotton and juari, while the soil is not equal to that of the best wheat and linseed tracts, and the only crop which really flourishes on it is tur. Great allowances have therefore to be made before the record of experiments is subjected to criticism.

3. The report this year possesses special interest, as attached to it is a Note by Dr. Leather, the Agricultural Chemist to the Government of India, who spent several days in the rains in the detailed inspection of the Farm, and the experiments conducted on it. Dr. Leather's Note reviews some of the past work on the Farm prior to the year now under report, and the various suggestions which he has made will receive attention: a separate reference will be made on some of the matters referred to in it.

4. I will proceed to refer to some of the more important experiments of the regular series. Although there was no rain to speak of between the 15th November and the end of March, the heavy fall of the first half of November caused serious damage from rust to wheat and linseed, and much detracted from the value of the experiments; but, it was clear from the experience of the year, that early sowing enables the plants to resist with some success the attack of this fungoid disease to which the later sown wheat succumbed. There is, however, great risk in this early sowing of a heavy subsequent fall washing out the seed or swamping the young plants. This was the case in the year under report, and

some of this early wheat had to be resown. Experiments will be made with a view to the discovery of some rustproof variety of wheat; but it is probable that no practical means for the protection of wheat from rust will be attained until the origin of the fungoid can be discovered.

5. The most important experiments and those which have been continued for the longest time (now amounting to 10 years) are the experiments bearing the serial numbers 17 and 18. So far as these experiments have proceeded they show that nitrogenous manure is the one most needed by the plants. Saltpetre has added during the past nine years about 350 lbs. per acre to the produce, or something like Rs. 12, but its cost is practically prohibitive. The gain with irrigated wheat is larger, and amounts to about 600 lbs., but in the greater number of years the soil of the Farm is sufficiently moist, and irrigation is superfluous. Cattle-dung has added about 130 lbs. per acre to unirrigated wheat, and about double that amount to irrigated wheat. The outturn of unmanured irrigated wheat is, in soil of this kind, frequently lower than that of the unirrigated crop, so that the additions due to these manures are much discounted when the total outturns of the irrigated and unirrigated crops are compared. This series of experiments also shows that bone-dust adds but little to the outturn, and green-soiling with 'san hemp' (*Crotalaria Juncea*) has not been very successful.

6. The above experiments are in full accord with my experience of the country in which the Farm is situated. The cultivators fully appreciate the greater advantage of manure in irrigated land, or for crops grown in the rainy season. They will not devote much cattle-dung to the unirrigated wheat in all places where it can be sold readily as fuel, but in those parts where the kharif or autumn crops grow well, the manure is largely and not sparingly sold as fuel. On the other hand, the comparatively small advantage to be gained by the use of bone-dust or phosphatic manure is illustrated by these experiments and those of the Ville series (No. 19), in which the withdrawal of calcic superphosphate or calcic sulphate causes no appreciable diminution in the outturn, while the withdrawal of nitrogenous manures reduces the outturn by a half.

7. To turn next to the more recent experiments: one of the most interesting of these is serial No. 4—to test the effect of deep ploughing. Opinions differ largely as to the effect of deep tillage, and the general practice of the cultivator is to merely 'bakhar' harrow the ground; but I have been informed by a landowner of experience that by resorting to deep tillage he has added considerably to his outturns, and there can be no doubt that the mere scratching which the cultivators consider sufficient is often the cause of the small outturns which they themselves complain of. So far as can be judged from the four years' experiments recorded under this serial number, deep ploughing every third year with simple harrowing in the intermediate years is the most profitable tillage. We have as yet too few experiments for any decision to be formed. Many of the experiments merely test the expediency of native practices, such as the growing of cotton in a mixture with tur (serial No. 5), or of wheat as a mixture with gram (serial No. 6). Serial No. 7 tests the common rotations with wheat, and there are several experiments in green-soiling with the seeds tarota and poorodia. None of them are however as yet very conclusive. Embankment for wheat has proved a failure; it is but little practised in the Nagpur country, although so profitable in Jubbulpore. The soil here is too moist as it is, and embankment merely makes it water-logged. Serial No. 11 brings out the superiority of box-dung to stall-dung, and again shows that bone-dust is of but little use in the soil of this locality. The box-dung doubled the outturn, as compared with that of the unmanured plot. The experiments with rotation are of too short a period to be as yet of any value, but they will be continued systematically.

8. Among the special experiments not of the regular series were two to test the comparative merits of different varieties of cotton. The yields were poor owing to the excessive rain-fall, but such as they were, they were highest in the case of the long-stapled cotton, Upland Georgian, which was priced the highest at the Empress Mills. Nimari, also a long-stapled cotton, did well. As

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long as the growth of the short-stapled local variety, jari, is encourged by the trade for purposes of adulteration, so long will the cultivators continue to grow it, for its yields are nearly always so much larger than that of the 'bani' as to compensate for its lower price. Experiments undertaken to test the effect of using rusted wheat seed showed that there was no material difference between the crops grown from rusted seed and those raised from healthy seed. The disease is evidently one which does not lie latent in the seed, as indeed might be inferred from the fact that wheat cultivation has continued in these Provinces, in spite of attacks of rust, in days when imported seed could not be readily obtained. The experiment of growing a leguminous crop as a mixture with linseed, with a view to arresting the disease of 'talap' to which I have referred, proved useless.

9. The experiment noticed in last year's report for preventing the damage caused to wheat crops by trees in their vicinity, was repeated this year with similar success. I beg to draw attention to Dr. Leather's remarks on this subject at paragraph 27 of his Note. It seems tolerably certain that the damage is due to the surface roots of the trees which draw away the moisture from the wheat plants within their influence. The protection of the crop by the digging of trenches to a depth of 3 feet, and at a distance from the tree of from 3 to 12 feet, according to its size, has been now so successful on the Farm as to warrant the wider extension of an experiment which any cultivator will readily try for himself. In some of the well-wooded villages in every district the damage caused by the roots of the trees is often so large as to prevent the cultivation of wheat altogether, and many a cultivator finds an acre or two out of his holding useless to him on this account.

10. The report concludes with a brief notice of the Agricultural Class attached to the Farm. The junior class of the year was an exceptionally good one, principally because the students who joined comprised several who had passed the Entrance Examination. Dr. Leather's remarks on this subject will be the subject of a separate reference; and I will only remark here that unless further employment is found for the students, the class cannot continue for very long. Most of those who have hitherto passed have been provided for with Revenue Inspectorships; but this cannot go on indefinitely, as the number of appointments is limited. They might certainly be taken as Assistant Managers on Court of Wards Estates after undergoing, if necessary, a third year's course in the class, even if Dr. Leather's suggestion about their employment as peripatetic teachers be not considered feasible.

11. The Farm was managed by Mr. Joshi throughout the year, under the supervision of Mr. Fuller, and Dr. Leather has expressed himself well satisfied with the management and with the conduct of the experiments by Mr. Joshi. I have known Mr. Joshi for some time, and his practical method of working, and the keen interest he takes in the experiments and work of the Farm have always evoked the favourable comment of visitors to the Farm.

12. The report will continue, as recommended by Dr. Leather, to issue on a uniform plan to admit of comparison of several years' results, and more details of the outturns can be given than is at present the case; but I do not consider it advisable to omit the cost of the experiments from the tables altogether, as we cannot judge of the practical value of an experiment without calculating the cost.

I have the honour to be,

Sir,

Your most obedient Servant,

R. H. CRADDOCK,

Offg. Commr. of Settlements and Agriculture.

Secretariat Press, Nagpur;—17-1-95.—400.

No. 32 of 1894.

SUBJECT.

Report on the Nagpur Experimental Farm for the year 1893-94.

FROM

THE SUPERINTENDENT,

GOVERNMENT EXPERIMENTAL FARM,

Nagpur,

To

THE COMMR. OF SETTLEMENTS AND AGRICULTURE,

Central Provinces.

Dated Nagpur, the 21st July 1894.

SIR,

I have the honour to submit the Annual Report on the working of the Experimental Farm, Nagpur, for the year ending 31st March 1894.

SEASON.

2. The regular monsoon set in about the latter half of June. About 9 inches of rain fell in June, which facilitated early sowings. The total rainfall of the year amounted to 51·19 inches, exceeding by 1·50 inches the average of the preceding 19 years. The following table shows the amount and distribution of the rainfall with the average of the preceding 19 years :—

Month.	Number of rainy days.	Rainfall.	Average of 19 years preceding.	Month.	Number of rainy days.	Rainfall.	Average of 19 years preceding.
		Inches.	Inches.			Inches.	Inches.
April ... 1st half ...	...	...	·10	October ... 1st half ...	3	4·89	1·47
April ... 2nd half ..	...	·09	·23	October ... 2nd half ...	2	·94	1·47
May ... 1st half ..	...	...	·27	November .. 1st half ...	5	2·96	·59
May ... 2nd half ...	4	·81	·25	November .. 2nd half ...	...	...	·22
June ... 1st half ...	4	4·35	3·03	December... 1st half ...	...	...	·15
June ... 2nd half ...	5	5·49	4·92	December... 2nd half ...	...	...	·37
July ... 1st half ...	7	5·36	7·69	January ... 1st half ...	1	·12	·45
July ... 2nd half ...	7	2·23	7·05	January ... 2nd half ...	...	...	·27
August ... 1st half ..	8	4·86	6·43	February... 1st half ...	...	...	·12
August ... 2nd half ...	11	10·89	4·36	February... 2nd half ...	...	...	·27
September.. 1st half ...	7	4·53	4·76	March ... 1st half ...	...	...	·28
September.. 2nd half ...	5	3·51	4·72	March ... 2nd half ..	...	·16	·22
				Total ...	69	51·19	49·69

NOTE.—A rainy day is taken as one on which there was a fall of not less than 10 cents.

The ·85 inch of rain which fell during the hot weather was not of much assistance towards preparing the land by ploughing or bakharing. The rainfall of July and August was too heavy for the advantage of juar and cotton, but both the crops thrived well after its cessation. Although sufficient time was not given by the continuity of the rain for working the daura or doondia to weed the fields, the cotton and juar crops were about fourteen annas in the rupee. The rabi sowings were commenced in good time, but heavy rain which fell at the end of October and the beginning of November damaged the sprouting crops severely, and some land had to be resown—save for a sprinkling in January, there was no rain after the fields were resown throughout the whole of the cold season. The early sown fields at the outset made poorer growth than those which were resown, but they escaped rust, whereas all the resown fields suffered from rust, and most of them very badly. Our experience has been that late sown fields always suffer from rust. The manured and heavy crops suffer more from rust than unmanured and thin crops. The threshing was completed earlier than usual, as there was no rain to hinder it.

All the operations of the experimental fields require special attention and care, but particular care is required on the threshing floor. As soon as a crop is reaped, it is tied up in bundles, and the weight and girth of each sheaf are noted. At the time of threshing the sheaves are again measured and weighed. In girth there is a loss of about 2 inches in every 3 feet, while the weight decreases from 5 to 10 per cent. according to the dryness of the crops at the time of reaping.

3. The experiments conducted on the Farm are classed as (1) continuous or permanent experiments, (2) special experiments. A portion of the area grows non-experimental crops. Plots appropriated to continuous experiments are cropped according to the programme in Annexure D. The special experiments are based on lines framed each year.

4. I will first of all give the results of those experiments which form a part of a continuous series :—

Serial No. 1.— FIELD No. 14.—SUBJECT.—*Green-soiling for wheat and cotton.*

Plot 1.—Area 0·18 acre. Green-soiling followed by fallow and then by wheat.
„ 2. „ 0·18 „ As above, but unmanured.
„ 3. „ 0·18 „ Green-soiling followed by wheat and then by cotton.
„ 4. „ 0·21 „ As above, but unmanured.
Commenced in 1891-92. Plots 1 and 3 were green-soiled during the year under repc
For cropping see Column 2 below.

No. of Plot.	Crop.	Actuals, 1893-94. Outturn per acre. Grain.	Straw.	Value.	Cost of cultivation per acre.	Total from commencement of experiment (three years). Cost of cultivation, including green-soiling.	Value of produce per acre.
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p	Rs. a. p.
1	Fallow ...	...	...	...	*14 11 8	40 13 8	36 6 8
2	Do. ..	...	...	...	4 3 2	22 3 4	31 6 4
3	Wheat ...	678	1,378	24 1 10	*33 8 10	54 4 11	71 5 11
4	Do. ...	687	1,419	24 8 3	12 14 4	35 14 0	66 7 9

* Including cost of manuring.

The wheat was sown on October 26th and was not resown. Its outturn on both plots was satisfactory. Green-soiling produced no effect. In the preceding year it added to the cotton crop, but not sufficient to cover its cost.

Serial No. 2.—FIELD No. 17.—SUBJECT.—*Effect of green-soiling with cut weeds known as* tarota, *in alternate years on cotton, and wheat in rotation.*

Plot 1.—Area 0·15 acre. Green-soiled with cut weeds every alternate year.
„ 2. „ 0·08 „ No manure.
Both plots cropped with cotton and wheat alternately. Wheat in the year of green-soiling.
Commenced in 1890-91. Unirrigated crop during 1893-94, cotton (upland Georgian).

No. of Plot.	Crop.	Actuals, 1893-94. Outturn per acre. Lint.	Seed.	Value.	Cost of cultivation per acre.	Total from commencement of experiment (four years). Cost of cultivation, including green-soiling.	Value of produce per acre.
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Cotton ...	49	120	13 0 9	8 0 11	72 13 3	73 12 11
2	Do. ...	40	105	10 12 3	10 12 11	55 8 7	50 3 6

Tarota (*Cassia tora*) is a Cœsalpinia weed, and in future a papilionaceous weed will be substituted for it. Its application in the preceding year has added little or nothing to the outturn of cotton, but it added greatly to the produce of wheat directly following it.

Serial No. 3.—FIELD No. 18.—SUBJECT.—*Relative effect of green-soiling, box-dung and stall-dung on wheat grown continuously.*

Plot 1.—Area 0·25 acre. Green-soiled with Bawachi (*Psoralia*) every year.
„ 2. „ 0·25 „ Unmanured.
„ 3. „ 0·25 „ Manured with box-dung at 240 maunds per acre.
„ 4. „ 0·25 „ Manured with stall-dung at 160 maunds per acre.
Commenced in 1890-91. Unirrigated crop in 1893-94, wheat (haura) Harda.

No. of Plot.	Actuals, 1893-94.						Average for three previous years.			
	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	Gain in value on Plot 2.	Outturn per acre.			Gain in value on Plot 2.
	Grain.	Straw.	Value.				Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	720	1,060	24 2 1	10 11 0	6 13 0	9 7 4	622	924	23 3 2	2 11 2
2	416	812	14 10 9	11 8 0	...	...	551	782	20 8 0	...
3	760	1,508	26 14 4	10 15 4	12 7 0	12 3 7	672	1,165	25 8 10	5 0 10
4	600	936	20 4 9	11 9 4	11 14 0	5 10 0	682	948	25 4 6	4 12 6

In this experiment the green-soiling plant used was the papilionaceous weed (*Psoralia coryllifolia*) which grows commonly on the Farm. It was sown on the land and ploughed in, and hence cost less than Rs. 7 per acre, while green-soiling in the two experiments with cut weeds in serial numbers 2 and 8 was far more expensive. The wheat was sown on the 26th October, and suffered very little from rust. The results follow those of the preceding year very closely, and the experiment is a very satisfactory one.

Serial No. 4.—FIELD No. 21.—SUBJECT.—*The effect of deep tillage on wheat.*

Plot 1.—Area 0·08 acre. Ploughed every year.
„ 2. „ 0·08 „ Bakhared (scarified) every year.
„ 3. „ 0·08 „ Scarified every year, and ploughed every third year.
Commenced in 1890-91. Crop, wheat (soft white) pissi. Unirrigated and unmanured.
During 1893-94 plot 3 was ploughed as well as scarified.

No. of Plot.	Actuals, 1893-94.					Average for three previous years.			
	Outturn per acre.			Cost of cultivation per acre.	Gain in value of produce on Plot 2.	Outturn per acre.			Gain in value of produce on Plot 2.
	Grain.	Straw.	Value.			Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	412	681	14 5 5	13 14 11	−4 10 2	377	779	14 5 9	−5 15 3
2	516	1,131	18 15 7	12 11 1	...	544	1,090	20 5 0	...
3	622	1,125	22 0 0	13 14 11	+3 0 5	596	1,155	22 8 7	+2 3 7

The wheat was sown on 25th October in all the three plots and was not resown. The kind of wheat sown was pissi. There were only traces of rust, and I found that only 94 grains of wheat went to the dram, which shows that the wheat was but little affected by rust. Plot No. 3 which was ploughed up this year has, as in previous years, given the best results. But I think that it is naturally rather the better plot of the three, and the experiment must be continued before its results can be accepted as really reliable.

Serial No. 5.—FIELD No. 23.—SUBJECT.—*The effect of growing cotton in a mixture instead of alone.*

Plot 1.—Area 0·24 acre. Cotton jari alone.
„ 2. „ 0·24 „ Cotton jari and tur in the proportion of 6 lines to 2.
„ 3. „ 0·24 „ Cotton jari and juar do. do.
Commenced in 1893-94. Manured with 160 maunds dung in 1893-94.

No. of Plot.	Actuals, 1893-94.						Remarks.
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	
		Grain or lint.	Straw or seed.	Value.			
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
1	Cotton ...	44	85	9 4 10	7 5 4	12 6 7	
2	Cotton and tur ..	27 658	52 1,237	23 5 11	11 9 9	12 6 7	
3	Cotton and juar.	22 41	46 673	12 7 5	*6 13 4	12 6 7	

* Exclusive of cost of watching.

The admixture of tur or juar reduced the outturn of cotton by a half, but they were sown rather more closely than according to usual practice. Tur gave a good profit. It is on the whole the crop which does best on the Farm. The juar was unsatisfactory.

Serial No. 6.—FIELD No. 25.—SUBJECT.—*The effect of growing wheat mixed with gram.*

Plot 1.—Area 0·21 acre. Wheat sown alone.
„ 2. „ 0·21 „ Wheat mixed with gram.
Commenced in 1890-91. Crop, wheat (bold hard yellow) Indore haura.
Manured with 160 maunds dung in 1893-94 without irrigation.

No. of Plot.	Actuals, 1893-94.							Average for three previous years.				
	Outturn per acre.				Cost of cultivation per acre.	Cost of manuring per acre.	Gain in value on Plot 1.	Outturn per acre.				Gain in value on Plot 1.
	Kind.	Grain.	Straw.	Value.				Kind.	Grain.	Straw.	Value.	
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.		lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	Wheat ...	278	500	9 13 3	7 10 7	11 12 1	...	Wheat ...	513	717	18 7 0	...
2	Wheat and Gram.	214 43	583 86	9 11 1	8 10 11	11 12 1	—0 2 2	Wheat and Gram.	325 202	428 350	18 14 4	+ 0 7 4

The fields were sown on 26th October and were not resown. The crop was but slightly affected by rust, and 81 grains went to the dram. The wheat was the best in quality of any gathered this year; but the outturn was very small. One part of gram was sown in Plot No. 2 to two parts of wheat, and it will be observed that in the outturn there is only 1 part of gram to 5 parts of wheat. Admixture gave no increase in profit; but the outturns were very small, and a mistake was made in using foreign wheat (from Khandwa) instead of the ordinary wheat of Nagpur.

Serial No. 7.—FIELD No. 29.—SUBJECT.—*Rotations with wheat.*

Plot 1.—Area 0·13 acre. Wheat every year.
„ 2. „ 0·13 „ Wheat and fallow alternately.
„ 3. „ 0·13 „ Wheat and gram do.
„ 4. „ 0·13 „ Wheat and juar and tur do.
„ 5. „ 0·13 „ Wheat and kodon do.
Commenced in 1890-91. Unmanured and unirrigated.
For cropping see Column 2 below.

No. of Plot.	Crop.	Actuals, 1893-94. Outturn per acre. Grain.	Straw.	Value.	Cost of cultivation per acre	Total outlay in cultivation per acre since commencement of experiment (four years).	Total value of produce per acre since commencement of experiment (four years).	Total profit per acre since commencement of experiment (four years).
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Wheat ...	607	762	20 3 11	9 14 4	34 1 0	91 9 5	57 8 5
2	Fallow ...	...	...	...	3 6 6	19 9 9	47 0 10	27 7 1
3	Gram ...	538	1,346	18 5 10	9 7 11	32 9 6	73 14 10	41 5 4
4	Juar-Tur ...	200 356	1,735 1,100	32 1 9	13 10 7	*37 1 10	112 10 9	75 8 11
5	Kodon ...	600	335	9 3 4	12 7 4	*34 15 7	51 12 3	16 12 8

* Exclusive of cost of watching.

The wheat was sown on the 29th October and was not resown. The largest profits are given by the plot on which wheat is rotated with juar-tur. The plot continually cropped with wheat comes next. Kodon as a rotation crop was sown last year to improve the outturn of wheat, but it is not profitable, as there is no sale for kodon grain at Nagpur.

Serial No. 8.—FIELD No. 32.—SUBJECT.—*Effect of green-soiling with cut weeds known as* tarota, *on wheat year after year.*

Plot 1.—Area 0·16 acre. Annually green-soiled with *tarota* and sown with wheat.
„ 2. „ 0·16 „ Unmanured and sown with wheat.
Commenced in 1891-92. Unirrigated crop in 1893-94, wheat (haura) Nagpur.

No. of Plot.	Crop.	Actuals, 1893-94. Outturn per acre. Grain.	Straw.	Value.	Cost of cultivation per acre.	Cost of green-soiling per acre.	Gain in value on Plot 2.	Total from commencement of experiment (three years.) Cost of cultivation, including green-soiling.	Value of produce per acre.
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Wheat ...	787	1,356	27 9 5	10 8 9	9 14 4	11 3 2	71 1 11	90 4 0
2	Do. ...	462	850	16 6 3	11 0 0	...	...	29 8 10	59 4 2

Here again a papilionaceous weed will in future be substituted for the *tarota*.

As in last year, green-soiling has greatly increased the outturn of wheat, but owing to cost of carriage it is an expensive process, and during the three years of experiment its use has entailed an extra outlay of Rs. 42, and brought in only Rs. 31 in return.

Serial No. 9.—FIELDS NOS. 41 & 43.—SUBJECT.—*The effect of embankment in enhancing the value of manure to a wheat crop.*

No. 41.—Area 0·62 acre. Embanked in 1885. Annually manured with 160 maunds dung per acre.
„ 43. „ 0·70 „ Ditto. Never manured.
Commenced in 1890-91. Crop, wheat (hard white Nagpur) haura. Unirrigated.

No. of field.	Actuals, 1893-94. Outturn per acre. Grain.	Straw.	Value.	Cost of cultivation per acre.	Cost of manuring per acre.	Average for three previous years. Outturn per acre. Grain.	Straw.	Value.
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.
41	422	447	13 14 2	11 15 6	11 3 8	743	1,193	27 4 8
43	283	321	9 4 11	10 7 0	...	468	726	17 3 2

The plots were resown, and suffered greatly from rust. The experiment has been discontinued. It has not shown that embankment adds to the produce of wheat on the Farm, and the stoppage of the drainage water caused damage to the surrounding land.

Serial No. 10.—FIELD No. 42.—SUBJECT.—*Relative effect of dung and bone-dust applied each year on juar and linseed grown in rotation.*

Plot 1.—Area 0·27 acre. Manured with dung at 160 maunds per acre.
„ 2. „ 0·27 „ Unmanured.
„ 3. „ 0·27 „ Manured with bone-dust at 360 lbs. per acre.
Commenced in 1890-91. Unirrigated crop in 1893-94 linseed *chawal katha* (white and red mixed).

No. of Plot.	Actuals, in 1893-94.							Average for three previous years.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	Gain in value on Plot 2.	Cost of cultivation, including manure per acre.	Value of produce per acre.
		Seed.	Stalks.	Value.					
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Linseed ..	115	352	8 0 9	6 13 7	11 13 2	—0 1 11	17 11 3	15 5 0
2	Do. ..	122	254	8 2 8	6 8 11	.....	.....	6 8 7	12 2 2
3	Do. ...	126	228	8 5 2	6 1 6	4 6 1	+0 2 6	9 10 7	12 9 5

This was one of the few linseed crops on the Farm which did not fail entirely. During 1891-92 linseed gave practically no return on these plots, and their improved produce after juari may be the result of differences in season, but is worth noticing. Manuring produced no effect, and it is almost certain that to manure for linseed is a waste of money.

Serial No. 11.—FIELD No. 44.—SUBJECT.—*Relative effect of stall-dung, box-dung and bone-dust on cotton and wheat grown alternately.*

Plot 1.—Area 0·27 acre. Manured with stall-dung at 160 maunds per acre.
„ 2. „ 0·27 „ Manured with box-dung at 240 maunds per acre.
„ 3. „ 0·27 „ Unmanured.
„ 4. „ 0·27 „ Manured with bone-dust at 360 lbs. per acre.
Commenced in 1890-91. Unirrigated crop in 1893-94 wheat (haura) Nagpur.

No. of Plot.	Actuals, 1893-94.							Average for three previous years.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	Gain in value on Plot 3.	Cost of cultivation, including manure per acre.	Value of produce per acre.
		Grain.	Straw.	Value.					
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Wheat ...	724	1,363	25 12 10	11 3 11	11 6 1	+10 5 5	19 10 8	12 1 7
2	Do. ...	995	1,507	34 1 11	10 15 0	12 2 2	+18 10 6	20 13 10	13 10 4
3	Do. ...	462	596	15 7 5	10 11 11	.....	.....	7 14 6	8 5 6
4	Do. ...	352	464	11 13 1	10 4 10	4 6 1	—3 10 4	11 8 11	7 15 8

The wheat was sown on the 30th October and was not resown. Here again box-dung shows very well, and more than covers its cost, though it is charged for in the accounts very heavily. It is used in 50 per cent. larger quantity than stall-dung, because of the weight of litter it includes; but it has been charged for weight for weight equally with stall-dung. Bone-dust has again given no increase in produce.

Serial No. 12.—FIELD No. 57.—SUBJECT.—*Rotations with linseed.*

Plot 1.—Area 0·28 acre. Linseed every year.
„ 2. „ 0·28 „ Linseed and gram alternately.
„ 3. „ 0·28 „ Linseed and cotton do.
„ 4. „ 0·28 „ Linseed and tur do.
Commenced in 1890-91. Unmanured and unirrigated.
For cropping see Column 2 below.

No. of Plot.	Actuals, 1893-94.					Total outlay in cultivation since commencement of experiment (four years).	Total value of produce per acre since commencement of experiment (four years).
	Crop.	Outturn per acre.			Cost of cultivation per acre.		
		Grain.	Straw.	Value.			
		lbs.	lbs.	Rs. p. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Linseed	11	36	0 12 4	4 15 5	23 5 5	8 15 7
2	Gram ...	473	652	14 7 7	7 7 11	28 1 1	22 8 2
3	Cotton (Broach)	24	62	6 4 10	5 12 7	26 14 8	22 14 7
4	Tur ...	684	2,168	19 11 0	10 4 7	31 5 9	41 4 6

Linseed again failed, as indeed it did in most fields. Cotton gave a poor outturn, and a mistake was made in sowing Broach cotton in this experiment instead of the local variety. The only plot which has given a fair profit is that on which tur is sown in rotation, and this is because of the good outturn of the tur.

Serial No. 13.—FIELD No. 61.—SUBJECT.—*Rotations with cotton.*

Plot 1.—Area 0·30 acre. Cotton-tur year after year.
„ 2. „ 0·30 „ Cotton in rotation with wheat.
„ 3. „ 0·30 „ Cotton in rotation with gram.
Commenced in 1893-94. Cotton-tur in all three plots. Unmanured and unirrigated.

No. of Plot.	Actuals 1893-94.						Cost of cultivation per acre.	Remarks.
	Crop.	Outturn per acre.				Value.		
		Cotton.		Tur.				
		Lint.	Seed.	Grain.	Stalks and bhusa.			
		lbs.	lbs.	lbs.	lbs.	Rs. a. p.	Rs. a. p.	
1	Cotton-tur ...	21	41	590	1,913	21 10 3	15 3 4	
2	Do. ...	27	52	613	1,960	23 9 2	16 5 4	
3	Do. ...	33	51	630	1,980	24 3 11	14 0 9	

This is the first year of the experiment, and there is nothing to remark upon except the general poverty of the yield of cotton. The cotton crop was much damaged by the late autumn rain.

Serial No. 14.—FIELD No. 63.—SUBJECT.—*Relative effect on linseed and cotton in rotation of box-dung and stall-dung applied in alternate years only.*

Plot 1.—Area 0·30 acre. Manured with box-dung at 240 maunds per acre.
„ 2. „ 0·30 „ Unmanured.
„ 3. „ 0·30 „ Manured with stall-dung at 160 maunds per acre.
Commenced in 1890-91. Crop in 1893-94, cotton (bani).
Unmanured during the year.

No. of Plot.	Actuals, 1893-94.					Average for three previous years.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of cultivation, including manure per acre.	Value of produce per acre.
		Lint.	Seed.	Value.			
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Cotton ...	47	147	13 0 7	9 15 5	18 1 9	8 2 7
2	Do. ...	24	69	6 8 10	9 14 10	9 0 0	9 6 4
3	Do. ...	39	124	10 13 6	9 14 4	17 7 6	10 12 1

The cotton crop was very poor, owing to the land being infested with the weed known as *nagarmotha* (*Cyperus pertennis*) which it is very difficult to eradicate. But the effect of the previous year's manuring is very plain.

Serial No. 15.—FIELD No. 65.—SUBJECT.—*Effect of liming soils on wheat in rotation with cotton.*

Plot 1.—Area 0·43 Acre. Manured with lime in 1890-91 (Not to be limed again until 1902-03).

„ 2. „ 0·43 „ Unmanured.

Commenced in 1890-91. Both plots manured with dung, at 160 maunds per acre in 1893-94.

Crop in 1893-94. Chanda cold weather jari cotton.

No. of Plot.	Actuals, 1893-94.							Average for three previous years.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	Gain in value of produce on Plot 2.	Cost of cultivation including manure per acre.	Value of produce per acre.
		Lint.	Seed.	Value.					
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Cotton ...	12	40	3 13 8	11 4 10	19 0 11	0 15 5	17 9 8	19 4 5
2	Do. ...	9	30	2 14 3	10 14 3	12 5 10	...	10 2 6	19 12 11

The cotton was grown here in the cold weather. It gave a very good return—only two pickings—but its produce is of excellent quality, and was valued at the Empress Mills at Rs. 92 per *bojha* of 345 lbs., the rates for other varieties ranging between Rs. 62 and Rs. 82 at the time. The produce of the limed plot is the larger of the two, but the difference is trifling.

Serial No. 16—FIELD No. 68.—SUBJECT.—*Effect on irrigated wheat of saltpetre drilled in with the seed and used as a top-dressing.*

Plot 1.—Area 0·10 acre. Unmanured.

„ 2. „ 0·10 „ Manured with saltpetre at 240 lbs. per acre drilled in with seed.

„ 3. „ 0·10 „ Manured with saltpetre applied as a top-dressing at 80 lbs. per acre.

Commenced in 1890-91. Crop in 1893-94, wheat (haura) Harda. Once irrigated on 22nd January 1894.

No. of Plot.	Actuals, 1893-94.								Average for three previous years.			
	Outturn per acre.			Cost of cultivation per acre.	Cost of manuring per acre.	Cost of irrigation.		Gain in value on Plot 1.	Outturn per acre.			Gain in value on Plot 1.
	Grain.	Straw.	Value.			Labour.	Assumed water-rate per acre of watering.		Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	457	990	16 7 8	14 6 10	...	1 5 8	2 0 0	...	595	1,255	22 13 5	...
2	569	1,145	20 3 2	14 5 2	14 11 0	1 4 0	2 0 0	+3 11 6	1,091	2,293	41 5 11	+18 8 6
3	437	600	14 7 10	14 4 4	4 14 4	1 0 8	2 0 0	—1 15 10	546	1,088	20 11 5	—2 2 0

The wheat was resown on the 23rd November and was seriously rusted. The weights are accordingly no guide to the effect of the manure. It is noticeable that Plot No. 3 has always given a less outturn than the unmanured plot (No. 1), and this seems to indicate natural inferiority. Next year the 80 lbs. saltpetre applied to it will be drilled in with the seed.

Serial No. 17.—SERIES A.—SUBJECT.—*Effect on wheat grown continuously of different kinds of manures applied year after year without irrigation.*

Plot 1.—Area 0·10 acre. Manured with Saltpetre, 240 lbs. per acre.
„ 2. „ 0·10 „ „ Bone-dust, 360 lbs. per acre.
„ 3. „ 0·10 „ „ Saltpetre, 240 lbs. and bone-dust 360 lbs. per acre.
„ 4. „ 0·10 „ „ Dung, 160 maunds per acre.
„ 5. „ 0·10 „ „ Dung, 160 maunds and bone-dust 360 lbs. per acre.
„ 6. „ 0·10 „ „ Ashes of 160 maunds dung per acre.
„ 7. „ 0·10 „ „ Unmanured.
„ 8. „ 0·10 „ „ Green-soiled with *san* hemp.
Commenced in 1884-85. Unirrigated. Crop in 1893-94, wheat (haura) from Harda.

No. of Plot.	Actuals, 1893-94.						Average for nine previous years.			
	Outturn per acre.			Cost of cultivation per acre.	Cost of manure per acre.	Gain in value on Plot 7.	Outturn per acre.			Gain in value on Plot 7.
	Grain.	Straw.	Value.				Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	682	1,077	23 2 0	12 6 4	14 11 0	8 10 4	1,053	1,613	35 3 2	12 3 9
2	560	810	18 11 5	11 12 4	3 6 2	4 3 9	783	1,178	26 3 2	3 3 9
3	860	1,265	28 13 1	12 13 0	18 1 2	14 5 5	1,048	1,646	35 8 11	12 9 6
4	671	1,342	23 12 6	12 13 0	11 7 4	9 4 10	824	1,431	28 5 8	5 6 3
5	832	1,000	27 1 0	12 13 0	14 13 6	12 9 4	853	1,311	28 3 4	5 3 11
6	573	950	19 9 6	12 10 6	11 5 8	5 1 10	863	1,427	28 13 10	5 14 5
7	413	790	14 7 8	11 12 4	...	...	694	1,108	22 15 5	...
8	601	1,120	21 0 3	12 11 4	10 3 4	6 8 7	680	1,098	23 1 9	...

The wheat was sown before the rainfall, and Plot No. 1 was so much damaged by swamping that it was decided to re-sow it. This has vitiated its results, as it suffered from rust in a much greater degree than the others. This explains its yield at a lower rate than Plot 3. The good outturn yielded by dung (Plot 5) is noticeable. The straw was relatively not nearly so heavy, and the superior weight of grain is due to superior strength of ear and quality of grain.

Serial No. 18.—SERIES B.—SUBJECT.—*Effect on wheat grown continuously of different kinds of manures applied year after year with irrigation.*

Plot 1.—Area 0·10 acre. Manured with Saltpetre, 240 lbs. per acre.
„ 2. „ 0·10 „ „ Bone-dust 360 lbs. per acre.
„ 3. „ 0·10 „ „ Saltpetre, 240 lbs. and bone-dust 360 lbs. per acre.
„ 4. „ 0·10 „ „ Dung, 160 maunds per acre.
„ 5. „ 0·10 „ „ Dung, 160 maunds and bone-dust 360 lbs. per acre.
„ 6. „ 0·10 „ „ Ashes of 160 maunds dung per acre.
„ 7. „ 0·10 „ „ Unmanured.
„ 8. „ 0·10 „ „ Green-soiling with *san* hemp.
Commenced in 1890-91. Crop in 1893-94 wheat—irrigated once from the 15th to the 19th Jany. 1894.

No. of Plot.	Actuals, 1893-94.								Average for three previous years.			
	Outturn per acre.			Cost of cultivation per acre.	Cost of manure per acre.	Cost of irrigation.		Gain in value on Plot 7.	Outturn per acre.			Gain in value on Plot 7.
	Grain.	Straw.	Value.			Labour.	Assumed water-rate per acre watering		Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	501	1,160	18 5 4	12 7 2	14 11 0	1 4 10	2 0 0	5 12 7	1,130	2,145	44 2 7	23 3 10
2	423	627	14 3 1	12 3 10	3 6 2	1 6 6	2 0 0	1 10 4	739	1,098	27 9 9	6 11 0
3	596	1,320	21 9 6	13 4 6	18 1 2	1 9 10	2 0 0	9 0 9	1,172	2,206	45 11 3	24 12 6
4	510	830	17 6 1	13 6 2	11 1 6	1 8 2	2 0 0	4 18 4	804	1,440	31 4 1	10 5 4
5	559	1,100	19 11 11	12 14 8	14 7 8	1 9 10	2 0 0	7 3 2	830	1,527	32 4 9	11 6 0
6	473	970	16 13 8	12 4 8	11 5 8	1 4 0	2 0 0	4 4 11	653	964	24 6 3	3 7 6
7	364	630	12 8 9	12 6 4	...	1 5 8	2 0 0	...	548	907	20 14 9	...
8	463	870	16 3 4	11 2 4	11 4 10	1 12 4	2 0 0	3 10 7	600	1,230	23 11 0	2 12 3

This is an irrigated duplicate of Series A. Here also Plot 1 was resown with unfortunate result. The whole series was violently attacked by rust. The plots were once watered in January, in order to maintain the continuity of the experiment, and not because watering was needed. The amount of water given varied in different plots between 11,000 and 18,000 cubic feet per acre. Irrigation was of no service. But it does not seem to have done harm. The quality of the grain was no worse than that of the A Series of plots. In the case of both 107 grains went to the dram weight.

Serial No. 19.—Ville Series.—Subject.—*Practical method of soil analysis by using chemical manures, as devised by M. Georges Ville.*

Plot 1.—Area 0·05 acre. Manured with Ammonic chloride at 140 lbs. per acre.
" Calcic superphosphate at 180 lbs. per acre.
" Potassic sulphate at 90 lbs. per acre.
" Calcic sulphate at 100 lbs. per acre.
" 2. " 0·05 " As above, less calcic superphosphate.
" 3. " 0·05 " As in Plot 1, less ammonic chloride.
" 4. " 0·05 " No manure.
" 5. 0·05 " As in Plot 1, less potassic sulphate.
" 6. " 0·05 " As in Plot 1, less calcic sulphate.

Commenced in 1890-91. Crop in 1893-94 wheat (local haura). Irrigated once.

No. of Plot.	Actuals, 1893-94.				Average for three previous years.			
	Outturn per acre.			Gain in value on Plot 4.	Outturn per acre.			Gain in value on Plot 4.
	Grain.	Straw.	Value.		Grain.	Straw.	Value.	
	lbs.	lbs.	Rs. a. p.	Rs. a. p.	lbs.	lbs.	Rs. a. p.	Rs. a. p.
1	786	1,129	26 11 9	14 3 4	1,048	2,605	44 8 4	21 11 2
2	799	1,150	27 2 10	14 10 5	1,032	2,520	44 4 0	21 6 10
3	430	540	14 5 6	1 13 1	540	1,358	23 8 6	0 11 4
4	374	485	12 8 5	...	535	1,263	22 13 2	...
5	606	1,120	21 8 4	8 15 11	1,143	2,542	47 9 4	24 12 2
6	782	1,040	26 4 8	13 12 3	975	2,457	41 11 6	18 14 4

The wheat was resown. Rust was at its work here, and no less than 139 grains of the produce went to the dram weight. The results so far as they go corroborate those of past years as to the paramount importance of nitrogen. The omission of potassic sulphate apparently lowered the produce of Plot No. 5, but this is probably accidental.

(B).—Special Experiments.

5. I now give details of special experiments that were conducted during the year under report. These were made to compare—

(1) the yield of indigenous varieties of cotton with that of acclimatized American varieties;

(2) the comparison of rusted wheat seed with good wheat seed;

(3) The effect of mixing gram with linseed in preventing linseed disease called *talap*;

(4) the yield of different varieties of linseed;

(5) the yield of juar sown unmixed *versus* juar sown mixed with tur;

(6) The effect of selection of wheat seed.

Fields Nos. 37 & 55.—SUBJECT.—*Different varieties of cotton.*

Field No. 37—

Plot 1W—Area 0·17 acre. Cotton Jari.
„ 1E „ 0·17 „ „ Bani.
„ 2W „ 0·17 „ „ Nimari.
„ 2E „ 0·17 „ „ Upland Georgian.
„ 3W „ 0·17 „ „ Tree.
„ 3E „ 0·17 „ „ Broach.

Field No. 55—

Plot 1.—Area 0·27 acre. Cotton Jari.
„ 2. „ 0·27 „ „ Bani.
„ 3. „ 0·27 „ „ Nimari.
„ 4. „ 0·27 „ „ Upland Georgian.
„ 5. „ 0·27 „ „ Tree.

No. of field.	No. of Plot.	Area.	Treatment in preceding year.		Treatment in year under report.		Outturn per acre.			Cost of cultivation per acre.	Cost of manure per acre.	Gain in value on plot sown with *jari*.
			Crop.	Manure.	Crop.	Manure and rate. per acre.	Lint.	Seed.	Value.			
		Acres.					lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
37	1W	·17	Tur ...	*Nil* ..	Cotton, Jari ...	Dung 160 maunds.	55	106	11 10 0	8 8 0	12 6 3	...
	1E	·17	„ ...	„ ...	„ Bani ...	„ ...	49	145	13 7 4			+1 13 4
	2W	·17	„ ..	„ ...	„ Nimari ...	„ ...	53	152	15 1 6	8 6 10	12 6 3	+3 7 6
	2E	·17	„ ...	„ ...	„ Upland Georgian ..	„ ...	59	144	15 11 3			+4 1 3
	3W	·17	„ ...	„ ...	„ Tree ..	„	51	126	12 5 3	7 11 3	12 6 3	+0 11 3
	3E	·17	„ ...	„ ...	„ Broach ...	„ ...	45	112	11 12 0			+0 2 0
55	1	·27	Wheat...	Dung ...	Cotton Jari ...	Dung 160 maunds.	54	111	11 8 5	8 5 4	11 10 9	...
	2	·27	„ ..	„ ...	„ Bani ...	„ ...	41	123	11 4 7	8 7 2	11 10 9	−0 3 10
	3	·27	„ ...	„ ...	„ Nimari ...	„ ...	39	119	11 3 7	7 15 6	11 10 9	−0 4 10
	4	·27	„ ...	„ ...	„ Upland Georgian...	„ ...	51	122	13 8 6	8 5 0	11 10 9	+2 0 1
	5	·27	„ ...	„ ...	„ Tree ...	„ ...	53	132	12 14 8	8 5 0	11 10 9	+0 6 3

The experiments are duplicate of each other. I give the description of staple and the rate at which each variety was priced by the Manager of the Empress Mill.

Jari.—Coarse, woolly, clean, white, but very short and very weak; priced Rs. 62 per *bojha* of 345 lbs.

Bani.—Fine, silky, white, but not so strong nor so long as *nimari*, but still as good as pure Hinganghat; priced Rs. 78 per *bojha*.

Nimari.—Fine, silky, strong cotton, slightly coloured, long staple; priced Rs. 82 per *bojha*.

Upland Georgian.—Somewhat coarse and weak, but as long a staple as *bani*, well suited for good spinning; priced Rs. 78 per *bojha*.

Tree.—Fine, white, clean, as long as *bani*, but very weak, not to be preferred for spinning; priced Rs. 70 per *bojha*.

Broach.—Fine, white, but uneven staple, same as *bani*, but very weak; priced Rs. 76 per *bojha*.

The outturns are throughout very poor, but it is satisfactory that the upland Georgian acclimatized on the Farm should have shown best.

Nimari has very nearly as good results, and will be tried again. There is but little to choose between the yield of the two local varieties *jari* and *bani*. The former gave the larger outturn, while the latter commanded the better price.

Field Nos. 38, 39 and 40.—SUBJECT.—*Comparison of rusted wheat seed with good wheat seed.*

Field No. 38—

Plot 1N.—Area 0·06 acre Harda wheat.
„ 1S. „ 0·06 „ Shrivelled haura.
„ 2N. „ 0·06 „ Best local „
„ 2S. „ 0·06 „ Shrivelled „

Field No. 39—

Plot 1E.—Area 0·14 acre Local haura wheat.
„ 1W. „ 0·14 „ Harda wheat.
„ 2E. „ 0·14 „ Local haura wheat.
„ 2W. „ 0·14 „ Shrivelled haura.

Field No. 40—

Plot 1N.—Area 0·06 acre local haura wheat.
„ 1S. „ 0·06 „ Harda wheat.
„ 2N. „ 0·06 „ Shrivelled haura.
„ 2S. „ 0 06 „ Harda wheat.

No. of field.	Sub-plot.	Area.	Treatment in preceding year.		Treatment in year under report.		Outturn per acre.			Cost of cultivation per acre.	Cost of manure per acre.	Remarks.
			Crop.	Manure.	Manure.	Crop.	Grain.	Straw	Value.			
		Acres.					lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
38	1N	·06	Safflower.	*Nil* ...	*Nil* ...	Harda wheat ...	557	887	18 14 7	14 8 8	...	
	1S	·06	„ ...	„ ...	„ ...	Shrivelled haura wheat..	432	608	14 10 3			
	2N	·06	„ ...	„ ...	„ ...	Best local „ „ ...	537	754	17 13 10	16 1 9	...	Watered once on 29th January 1894
	2S	·06	„ ...	„ ...	„ ...	Shrivelled „ „ ...	517	742	17 4 2			
39	1E	·14	Roselle ...	*Nil* ...	Dung 160 maunds.	Best local haura wheat..	247	559	9 12 2	12 11 10	11 6 2	Watered once from 29th to 31 January 1894.
	1W	·14	„ ...	„ ...	„ ...	Harda wheat ...	279	732	11 6 5			
	2E	·14	„ ...	„ ...	„ ...	Best local haura wheat..	413	923	14 15 11	11 13 3	11 2 0	
	2W	·14	„ ...	„ ...	„ ...	Shrivelled „ „ ..	542	1,025	19 5 5			
40	1N	·06	Tur ...	*Nil* ...	*Nil* ...	Best local haura wheat..	254	958	11 7 1	15 12 9	...	
	1S	·06	„ ...	„ ...	„ ...	Harda wheat ...	318	1,250	14 8 3			
	2N	·06	„ ...	„ ...	„ ...	Shrivelled haura wheat .	307	942	13 0 8	17 2 4	...	Watered once on 3r February 1894.
	2S	·06	„ ...	„ ...	„ ...	Harda wheat ...	233	1,442	12 9 0			

The object of this experiment was to ascertain whether wheat-seed shrivelled by rust would yield good produce or not. All three fields were resown at the beginning of December, and were then very liable to rust during the season. Half of each field was irrigated. Shrivelled-seed gave, on the whole, as good a return as sound-seed. In two pairs of plots (39 unirrigated and 40 irrigated) it gave indeed a better return. Irrigation made no difference to the outturn in fields 38 and 40. In 39 it apparently lessened the outturn. All fields were rusted, No. 40 in a special degree, owing apparently to its vicinity to the embanked fields which caused it to be water-logged.

Field No. 22.—SUBJECT.—*Effect of mixing gram with linseed in preventing the linseed disease called* talap.

Plot 1.—Area 0·26 acre. Linseed and gram in mixture in proportion of 1 to 2 lbs.
„ 2. „ 0·26 „ Linseed alone.
„ 3. „ 0·26 „ Linseed and gram in mixture in proportion of 1 to 2 lbs.
Field manured with 160 maunds dung per acre in 1893-94.

No. of Plot.	Actuals, 1893-94.							Treatment in preceding year.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Cost of manure per acre.	Gain in value on Plot 2.	Crop.	Manure.
		Grain.	Straw.	Value.					
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.		
1	Linseed and gram.	33 238	204 338	9 0 4	7 15 7	11 11 10	3 1 2	Cotton ...	*Nil.*
2	Linseed ...	75	446	5 15 2	7 9 2	11 10 10	...	Cotton-tur ...	„
3	Linseed and gram.	33 242	254 362	10 5 7	7 15 7	11 15 0	4 6 5	Cotton-juar...	„

The linseed outturn of all three plots was very poor indeed, and all the plots showed signs of the disease known locally as *talap*, under which the plants dry up and die before maturity. The admixture of a leguminous crop does not appear to have been of any utility in strengthening the linseed against the disease, which now appears in almost every field of the farm in which linseed may be sown.

Field Nos. 15 and 33.—Subject—*White* versus *red linseed*.

Field No. 15—

Plot 1.—Area 0·23 acre. Linseed (white)

„ 2. „ 0·23 „ Do. (red)

Field No. 33—

Plot 1.—Area 0·39 acre. Linseed (white).

„ 2. „ 0·39 „ Do. (red).

„ 3. „ 0·39 „ Do. (white).

No. of field.	Sub-plot.	Area.	Treatment in preceding year.		Treatment in year under report.		Outturn per acre.			Cost of cultivation per acre.	Gain in value of produce per acre.
			Crop.	Manure.	Crop.	Manure.	Seed.	Stalks.	Value.		
		Acres.					lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.
15	1	·23	Gram.	*Nil*	Linseed (white).	*Nil*	46	343	3 15 2	7 1 1	5 9 10
...	2	·23	„	„	„ (red).	„	122	665	9 9 0	7 15 2	.....
33	1	·39	Cotton and tur.	*Nil*	Linseed (white).	*Nil*	92	633	7 11 6	7 11 3	0 9 4
...	2	·39	„	„	„ (red).	„	81	732	7 2 2	8 9 2	.....
...	3	·39	„	„	„ (white).	„	112	578	8 12 8	7 10 0	1 10 6

Results are inconclusive. Red linseed has done best in one plot and worst in the other.

Field No. 47.—Subject.—*Juar sown unmixed* versus *juar sown mixed with tur*.

Plot 1.— Area 0·36 acre. Juar and tur in mixture.

„ 2. „ 0·36 „ Juar alone.

„ 3. „ 0·36 „ Juar and tur in proportion of 6 lines of juar to 3 lines of tur.

„ 4. „ 0·36 „ Juar alone.

No. of Plot.	Actuals in 1893-94.					Treatment in preceding year.	
	Crop.	Outturn per acre.			Gain in value of produce.	Crop.	Manure.
		Grain.	Dry fodder (karbi) and stalks.	Value.			
		lbs.	lbs.	Rs. a. p.	Rs. a. p.		
1	Juar-tur ...	93 178	1,593 564	23 5 5	—5 13 4	Tur ...	*Nil.*
2	Juar ...	244	2,826	29 2 9	.....	„	„
3	Juar-tur ...	155 210	2,543 619	35 2 3	+1 1 2	„	„
4	Juar ...	134	3,062	34 1 1	.....	„	„

The outturns are very poor, and the value obtained results in most part from the juari stalks (for fodder). The admixture of tur has for this reason given no profit. It will be observed, however, that in Plot No. 3 the yield of juari fodder was larger than in plot No. 2, notwithstanding the less amount of juari seed sown.

Field No. 59.—SUBJECT.—*Effect of wheat-seed.*

Plot 1.—Area 0·31 acre. Selected seed.

„ 2. „ 0·31 „ Unselected „

„ 3. „ 0·31 „ Selected „

„ 4. „ 0·31 „ Unselected „

„ 5. „ 0·31 „ Selected „

Crop wheat (haura) Harda. Unmanured and unirrigated.

No. of Plot.	Actuals, 1893-94.						Treatment in preceding year.	
	Crop.	Outturn per acre.			Cost of cultivation per acre.	Gain in value of produce.	Crop.	Manure.
		Grain.	Straw.	Value.				
		lbs.	lbs.	Rs. a. p.	Rs. a. p.	Rs. a. p.		
1	Wheat ...	743	1,826	27 9 4	12 14 2	+0 4 9	Cotton.	Dung.
2	Do. ...	720	1,922	27 4 7	11 9 0	...	„	„
3	Do. ...	770	1,855	28 7 2	12 4 11	+4 8 3	„	„
4	Do. ...	667	1,413	23 14 11	11 14 4	...	„	„
5	Do. ...	633	1,494	23 4 4	13 3 3	+0 10 7	„	„

The wheat-seed used for Plots 1, 3 and 5 was carefully sifted, so as to eliminate all small grain. The outturns are good throughout. Judging from the first four plots, larger grained seed gave better produce. But in the 5th plot its outturn was the smallest of all. Plot No. 2 is situated between Plots Nos. 1 and 3, and the fall in the outturn of Plot No. 2 with its rise in Plot No. 3 certainly seems to show that the selection of seed added to the produce.

6. *Egyptian cotton-seed.*—A small parcel of Egyptian cotton-seed, including three varieties, received from the Director, Botanical Department, Northern India, Saharanpur, was sown in a non-experimental field (No. 21 A). The plants died off shortly after germination and gave no return.

7. *Fodder grass.*—Some seed of the kobi kattai grass (*Penisetum cenchroides riche*) referred to in Madras Agricultural Bulletin No. 27 was obtained from the Deputy Director of Agriculture, Madras, and was sown on a poor plot of land on the Farm and on the Telinkheri Reserve. The seed germinated very thinly, and has not produced fodder of any value in the year under report. But the plants have stood the hot weather and have seeded. It is possible that a close crop may spring up next year. On the Telinkheri Reserve the grass was choked by the natural grass of the place.

8. *The effect of trenches in checking the damage caused to spring crops by the roots of trees adjoining them.*—It has been supposed that trees damage crops by their shade; but this has not been found correct. The crop really suffers from lack of moisture caused by the absorption of the soil moisture by the tree roots. The experiment of cutting off the fine tree roots by digging trenches during the rains was noticed by the Commissioner of Settlements and Agriculture in his review of last year's Farm Report. The experiment has been continued with success, and the number of trenches has been increased. They are dug to a depth of 3 feet at distances varying according to the size of the tree from 3 to 12 feet from the tree trunk. The trenches were dug at the end of August, and kept open during the cold weather. Where protected by these trenches the wheat crop suffered no injury whatever, while elsewhere the proximity of trees damaged it very conspicuously. The trenches are filled up before the rains to prevent erosion, dead leaves are used in part for filling them, and this will lessen the trouble of re-excavating them next August.

9. *Effect of season on wheat and linseed crops.*—The table below shows the influence of season on wheat and linseed crops and the average outturn of these crops since 1884-85.

	1884-85.	1885-86.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.	1891-92.	1892-93.	1893-94.
	Inches.	Inches	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
September ...	14·21	3·57	4·69	8·64	5·75	5·63	13·92	24·69	11·54	8·04
October and first half of November.	0·71	1·61	10·69	6·62	0·61	4·00	2·59	0·59	3·74	8·79
Second half of November and from December 1st to January 15th.	2·68	4·17	0·63	1·88	0·78	...	2·62	...	2·13	0·12
From January 15th to March 31st.	1·97	0·66	...	0·50	0·01	0·26	2·66	0·57	5·36	0·16
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Compare average outturn of wheat (haura).	422	409	520	389	165	321	672	408	640	543*
Linseed ...	215	166	188	161	238	256	290	82	58	92

*Excluding the manure plots (Series A and B) and the Ville plots.

The season resembled that of 1887-88 very closely in the amount and distribution of the late autumn rainfall, and in 1887-88 also the outturn of both wheat and linseed was very poor.

The total area under cultivation during the year was 66·90 acres, of which 25·48 acres were experimental and 41·42 acres non-experimental. Details are given in Annexure A. Annexure B gives the average rate per acre of the cost of each process of cultivation as recorded in the case of each field in the Farm cultivation book. Annexure C shows the rates at which the produce has been valued. Annexure D gives a list of the continuous experiments now in progress on the Farm.

10. *Implements.*—The new implements bought in the year under report was a Sullivan's water-lift. Its cost, including the freight and setting charges, was Rs. 322-4-0. This is set up on a well in the Farm. Experiments were made to compare the efficiency of the lift with the ordinary well bucket (*mota*). The net result of the experiments is that the Sullivan's lift raises about 40 buckets per hour from a depth of 28 to 30 feet, and that the ordinary arrangement gives a rather larger number. The bucket used in both the experiments was the same, and its capacity is 34·95 gallons. The lift developes a great deal of friction, and is apparently harder on the bullocks than the ordinary bucket lift: it has already got out of order.

11. *Sewage Farm.*—The area leased out to the tenants of the sewage Farm during the year was 22·75 acres, out of which 6·75 acres are leased out at a reduced rate. Sixteen acres are leased out at Rs. 25 per acre, *plus* water-rate at 8 annas each acre watering.

12. *Live-stock.*—In March 1892 two bulls of the famous "Amrit Mahal" breed were procured from Mysore through the courtesy of the Resident. For some time after their arrival they were too fierce to be managed, and on one occasion they escaped and took to the jungles some 15 miles off. They have, however, now become much tamer. At first they refused to serve—probably because they were in over gross condition. It was determined to work them and after much trouble they have been taken to the plough with good bulls. Since last January they have covered seven cows.

13. *Agricultural Class.*—The working of the Agricultural Class is separately reported upon, and nothing beyond a very brief note is required here.

The year opened with 9 senior students. Twelve new students joined the Junior Class of exceptionally good capacity; five were scholarship-holders; seven had passed the Middle School and five the Entrance Examination. Practical field-work was as usual insisted upon. The senior students sowed both kharif and rabi crops on the half acre plots allotted to them, and the juniors sowed only rabi crops on their quarter acre plots. The total area under cultivation was 7·5 acres, and the students realized Rs. 79-14-9 by the sale of their crops, each one appropriating the produce of his own plot.

Unfortunately it was impossible to arrange for outside examiners in Botany and Geology and Mr. Fuller took these subjects as well as Agriculture. Mr. Craddock, Settlement Officer of Nagpur, examined in Chemistry, theoretical and practical. The results were encouraging. Seven out of the nine seniors passed the final examination, and 10 out of 12 juniors were promoted to the second year's course. The silver medal granted annually by Mr. Fuller to the best student was won by Jiyalal Tewari. Mr. Craddock kindly presented three prizes for Chemistry of the value of Rs. 35. At Mr. Fuller's suggestion the students were taken for a field day to the interesting quarries at Karodi and Bokhara, about eight miles from Nagpur, to learn something of practical working in Geology, and they were successful in finding some very interesting specimens.

In the Normal Agricultural Class for village schoolmasters, there were 33 pupils from 17 districts in the first term and 31 in the second term.

14. *Financial results.*—The expenditure and receipts of the year are shown below:—

	Expenditure.			Receipts.	Net cost.
	Salaries.	Contingencies.	Total.		
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Budget ...	4,524 0 0	5,039 0 0	9,563 0 0	2,050 0 0	7,513 0 0
Actual ...	4,040 10 7	4,938 14 7	8,979 9 2	2,373 9 11	6,605 15 3

I have the honour to be,

Sir,

Your most obedient Servant,

R. S. JOSHI,

Superintendent, Govt. Experimental Farm.

LIST OF ANNEXURES.

A.—Statement showing the total area under cultivation on the Experimental Farm, Nagpur, during 1893-94.

B.—Statement showing the average rates of the cost of cultivation on the Experimental Farm, Nagpur, during 1893-94.

C.—Statement showing the rates used for valuing the produce of the Experimental Farm, Nagpur, during 1893-94.

D.—Programme of continuous experiments as it stood on the 1st June 1894

E.—Note by Dr. J. Walter Leather on the Nagpur Experimental Farm.

F.— Ditto on the value of Indian Cattle-dung.

Annexure A.

Total area under cultivation on the Experimental Farm, Nagpur, during the year 1893-94.

Crop.	Area	Total.	Grand Total.
A.—EXPERIMENTAL AREA.	Acres.	Acres.	Acres.
(1). *Kharif*—			
Cotton alone	4·02		
Cotton and tur	1·14		
Cotton and juar	·24		
Juar and tur	·29		
Tur	·28		
Kodon	·29		
		6·26	
(2). *Rabi*—			
Wheat	11·62		
Wheat and gram mixed	·21		
Gram	·57		
Linseed	2·98		
Linseed and gram mixed	1·87		
Oats	·88		
Sugar-cane	·23		
Cotton (Chanda, cold weather jari)	·86		
		19·22	25.48
B.—NON-EXPERIMENTAL AREA.			
(1). *Kharif*—			
Cotton	·58		
Cotton and tur	·65		
Juar	1·57		
Juar and tur	·72		
Juar and mung	1·72		
Bajra and mung	1·04		
Guinea grass	·18		
Tur	11·98		
Popat	3·57		
Castor	1·05		
		23·06	
(2). *Rabi*—			
Wheat	9·58		
Linseed	4·49		
Linseed and gram mixed	·68		
Gram	2·39		
Gram and Safflower mixed			
Masur	·84	18·36	41·42
			66·90

Annexure B.

Statement showing the average cost per acre of each operation of cultivation on the Experimental Farm, Nagpur, during the year 1893-94, *as deduced from the Field Cultivation Book.*

[NOTE.—The hire of a pair of bullocks is taken as 12 annas, of a male cooly 3 annas, of a female cooly 1½ annas, and of a child 1 anna.]

Class of operation.	Detail.	Rate per acre. Rs. a. p.	Explanation.
Cost of tillage.	Ploughing by Swedish plough	1 7 3	A pair of bullocks and a man for 1·55 days.
	Hoeing by bakhar (bullock hoe)	0 8 9	Do. do. ·55 day.
	Weed hoeing by daura (small bullock weeding hoe)	0 5 2	Do. and 2 men for ·28 day.
	Do. by dundia (large do.) ...	0 5 8	Do. do. ·31 day.
	Weeding by hand	0 12 2	10 women for ·81 day.
Cost of sowing, including cost of seed.	Cotton by argarha (country drill hoe)	0 8 0	16 lbs. of seed (Re. 0-4-2). A pair of bullocks and a man and 3 women for ·19 day.
	Tur by do. do.	0 8 3	17 lbs. of seed (Re. 0-4-8) Do. for ·18 day.
	Juar by tifan (country drill)	0 6 5	9 lbs. of seed (Re. 0-3-7). A pair of bullocks and 2 men for ·15 day.
	Gram by nari nagar (drill plough)	1 6 10	23 lbs. of seed (Re. 0-13-0). Do. do. for ·54 day.
	Linseed by tifan (country drill)	1 5 5	14 lbs. of seed (Re. 0-13-6). Two pairs of bullocks and 3 men for ·23 day.
	Wheat by nari nagar (drill plough)	5 9 6	90 lbs. of seed (Rs. 3-13-8). Do. do. for ·84 day.
Cost of manure (excluding loading, carting and spreading).	Saltpetre	14 11 0	240 lbs. of seed @ Re. 4-14-4 per maund.
	Bone-dust	3 6 0	360 lbs., cost of collecting Re. 0-8-0 per maund and of crushing Re. 0-4-0 per maund.
	Cattle-dung	10 0 0	160 maunds @ Re. 0-1-0 per maund.
	Ashes of dung	11 0 8	160 maunds dung @ Re. 0-1-0 per maund, and drying and burning dung for ashes Re. 1-0-8 per acre.
	Green-soiling with *san* hemp	10 3 4	120 lbs. of seed Re. 2-11-4, sowing Re. 0-0-10, covering seed by harrow Re. 0-8-4, and cutting and ploughing Re. 6-14-10.
	Do. with *tarota* (*Cassia auriculata*) ...	9 14 4	Cutting and carting *tarota* Rs. 7-3-1 and ploughing Rs. 2-11-3.
Cost of harvesting.	Picking cotton	0 5 3	2 women for 1·75 day—each picking.
	Reaping juar	0 11 2	8 do. ·93 day.
	Do. gram	0 11 1	7 do. 1·05 days.
	Do. linseed	0 8 0	5 do. 1·06 days.
	Do. wheat	0 10 7	4 do. 1·76 days.
Cost of threshing and cleaning.	Ginning cotton (by country hand-charkha) ...	1 7 5	15 do. 1·04 day—average produce per acre 163 lbs. of seed cotton.
	Threshing and cleaning juar	0 6 7	1 man and 1 woman for 1·46 day——average produce per acre 167 lbs. grain and 2,695 lbs. of karbi.
	Do. gram	0 7 4	4 bullocks, 1 man, 2 women and 2 boys for ·22 day—average produce per acre 355 lbs. grain and 627 lbs. straw.
	Do. linseed	0 14 7	4 bullocks, 1 man, 2 women and 2 boys for ·45 day—average produce per acre 92 lbs. grain and 450 lbs. stalks.
	Do. wheat	1 1 11	4 bullocks, 1 man, 3 women and 2 boys for ·53 day—average produce per acre 558 lbs. grain and 1,015 lbs. straw.

Annexure C.

Statement showing the rates used for valuing the produce of the Experimental Farm, Nagpur, during the year 1893-94.

Name of produce.	Value.				Remarks.
	Rate.			Per.	
	Rs.	a.	p.		
Cotton ... Lint ... (according to quality) ...	92	0	0	Bojha of 345 lbs.	
	82	0	0		
	78	0	0		
	76	0	0		
	70	0	0		
	62	0	0		
Cotton seed	10	8	0	Khandi of 640 lbs.	
Juar — Grain	9	0	0	Khandi of 390 lbs.	
Juar — Karbi	35	0	0	Sheaves 1,000.	About 3,460 lbs.
Tur — Grain	9	5	6	Khandi of 421 lbs.	
Tur — Stalks	0	12	0	8 bundles.	About 560 lbs.
Tur — Bhusa	1	8	0	One cart-load.	Do. 478 lbs.
Gram — Grain	10	4	0	Khandi of 390 lbs.	
Gram — Chaff	1	8	0	One cart-load.	Do. 478 lbs.
Linseed (haura) ... Grain	24	0	0	Khandi of 385 lbs.	
Linseed (haura) ... Stalks and bhusa	1	8	0	One cart-load.	Do. do.
Do. (katha) ... Grain	23	0	0	Khandi of 385 lbs.	
Do. (katha) ... Stalks and bhusa...	1	8	0	One cart-load.	Do. do.
Do. (chavalkatha) Grain	23	4	0	Khandi of 385 lbs.	
Do. (chavalkatha) Stalks and bhusa...	1	8	0	One cart-load.	Do. do.
Wheat (haura) Nagpur — Grain	11	8	0	Khandi of 400 lbs.	
Wheat (haura) Nagpur — Straw	1	12	0	One cart-load.	Do. do.
Do. do. Harda ... Grain	11	4	0	Khandi of 400 lbs.	
Do. do. Harda ... Straw	1	12	0	One cart-load.	Do. do.
Do. (pissi) ... Grain	11	8	0	Khandi of 400 lbs.	
Do. (pissi) ... Straw	1	12	0	One cart-load.	Do. do.

Annexure D.

EXPERIMENTAL FARM, NAGPUR.

Programme of continuous Experiments as it stood on the 1st June 1894.

Serial No. of experiment.	No. of field.	Purpose of experiment.	Crop. 1st year.	Crop. 2nd year.	Crop. 3rd year.	Special treatment. 1st year.	Special treatment. 2nd year.	Special treatment. 3rd year.	Year (commencing June) in which experiment started.	Remarks.
1	14—1	Effect of green-soiling with *san* hemp. —on wheat with fallow interposed. —on wheat in rotation with cotton.	Fallow ...	Wheat (haura, Nagpur).	Fallow ...	Green-soiling with *san* hemp.	*Nil.*	Green-soiling with *san* hemp.	1891.	Cropping and treatment similar every other year.
	—2		do. ...	do. ...	do. ...	*Nil.*	do. ...	*Nil.*		
	—3		Wheat (haura, Nagpur).	Cotton (upland Georgian).	Wheat (haura, Nagpur.	Green-soiling with *san* hemp.	do. ...	Green-soiling with *san* hemp. ...		
	—4		do. ...	do. ...	do. ..	*Nil.*	do. ...	*Nil.*		
2	17—1	Effect on wheat and cotton in rotation of green-soiling with papilionaceous weeds (*Psorolia corilifora*).	Wheat (haura, Nagpur).	Cotton (jari, Nagpur.)	Wheat (haura, Nagpur).	Green-soiling with weeds cut from waste land.	*Nil.*	Green-soiling with weeds cut from waste land.	1890.	Ditto.
	—2		do. ...	do. ...	do. ...	*Nil.*	do. ...	*Nil*		
3	18—1	Relative effect of green-soiling, box-dung and stall-dung.	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Psorolia ...	Psorolia ...	Psorolia ...	1890.	Cropping and treatment similar every year.
	—2		do. ...	do. ..	do. ...	*Nil.*	*Nil.*	*Nil.*		
	—3		do. ...	do. ...	do.	Box-dung ...	Box-dung ...	Box-dung ..		
	—4		do. ...	do. .	do. ...	Stall-dung ...	Stall-dung ...	Stall-dung ..		
4	21—1	Effect of tillage to various depths.	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	To be ploughed every	year.		1890.	Ditto.
	—2		do. ...	do. ...	do. ..	To be hoed (bakhar	ed) every year.			
	—3		do. ...	do. ...	do. ...	To be ploughed every	third year, being hoed	during the other two.		
5	23—1	Effect of mixing crops—the principal one being cotton.	Cotton (jari, Nagpur).	Cotton (jari, Nagpur).	Cotton (jari, Nagpur)	*Nil.*	*Nil.*	*Nil.*	1893.	Cropping similar every year. Manure to be applied occasionally.
	—2		Cotton (jari) and tur in the proportion of 6 lines to 2.	Cotton (jari) and tur in the proportion of 6 lines to 2.	Cotton (jari) and tur in the proportion of 6 lines to 2.	do. ...	do. ...	do. ...		
	—3		Cotton (jari) and juar in the proportion of 6 lines to 2.	Cotton (jari) and juar in the proportion of 6 lines to 2.	Cotton (jari) and juar in the proportion of 6 lines to 2	do. ...	do. .	do. ...		
6	25—1	Effect of mixing crops—wheat and a leguminous crop (gram).	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	*Nil.*	*Nil.*	*Nil.*	1890.	Ditto.
	—2		Wheat (haura, Nagpur) and gram.	Wheat (haura, Nagpur) and gram.	Wheat (haura, Nagpur) and gram.	do.	do. ...	do. ...		
7	29—1	Effect of rotations with wheat ...	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	*Nil.*	*Nil.*	*Nil.*	1890.	Two year rotation, *i. e.*, the fourth year will follow the second.
	—2		do. ..	Fallow.	do. ...	do.	do. ...	do. ...		
	—3		do. ...	Gram.	do. ...	do.	do. ...	do. ...		
	—4		do. ...	Juar and tur.	do. ...	do.	do. ...	do. ...		
	—5		do. ...	Kodon.	do. ...	do.	do. ...	do. ...		
8	32—1	Effect on wheat of green-soiling with papilionaceous weeds (*Psorolia corilifora*)	Wheat (haura, Nagpur.)	Wheat (haura, Nagpur).	Wheat (haura, Nagpur).	Green-soiling with weeds cut from waste land.	Green-soiling with weeds cut from waste land.	Green-soiling with weeds cut from waste land.	1891.	Cropping and treatment similar every year. NOTE.—It is possible that this field may be irrigated.
	—2		do. ...	do. ...	do. ...	*Nil.*	*Nil.*	*Nil.*		

9	42—1 —2 —3	Relative effect of dung and bone-dust applied each year on juar and linseed grown in rotation.	Juar ... do. ... do. ...	Linseed (red) ... do. ... do. ...	Juar ... do. ... do. ...	Dung ... *Nil.* ... Bone-dust ...	Dung ... *Nil* ... Bone-dust ...	Dung ... *Nil.* ... Bone-dust ...	1890.	Manures continued every year. Crops to be in rotation.
10	44—1 —2 —3 —4	Relative effect on cotton and wheat in rotation of box-dung, stall-dung and bone-dust.	Cotton (upland Georgian.) do. ... do. ... do. ...	Wheat (haura, Nagpur.) do. ... do. ... do. ...	Cotton (jari, Nagpur) do. ... do. ... do. ...	Stall-dung ... Box-dung ... *Nil.* ... Bone-dust ...	Stall-dung ... Box-dung ... *Nil.* ... Bone-dust ...	Stall-dung ... Box-dung ... *Nil.* ... Bone-dust ...	1890.	Manures continued every year. Crops to be in rotation.
11	57—1 —2 —3 —4	Effect of rotations with linseed ...	Linseed (red) ... do. ... do. ... do. ...	Linseed (red) ... Gram ... Cotton (jari, Nagpur.) Tur ...	Linseed (red) ... do. ... do. ... do. ...	*Nil.* ... do. ... do. ... do. ...	*Nil.* ... do. ... do. ... do. ...	*Nil.* ... do. ... do. ... do. ...	1890.	Two year rotation, *i. e.*, the fourth year will follow the second.
12	61—1 — 2 — 3	Effect of rotations with cotton ...	Cotton (jari)—tur. do. ... do. ...	Cotton upland Georgian—tur. Wheat (haura, Nagpur.) Gram ...	Cotton (jari)—tur... do. ... do. ...	*Nil.* ... do. ... do. ...	*Nil.* ... do. ... do. ...	*Nil.* ... do. ... do. ...	1893.	Ditto.
13	63—1 —2 —3	Relative effect on linseed and cotton in rotation of box-dung and stall-dung applied in alternate years only.	Linseed (red) ... do. ... do. ...	Cotton (jari, Nagpur.) do. ... do. ...	Linseed (red) ... do. ... do. ...	Box-dung. ... *Nil.* ... Stall-dung ...	*Nil.* ... do. ... do. ...	Box-dung ... *Nil.* ... Stall-dung ...	1890.	To be manured with the same kinds of manure every alternate year, and crop to be in rotation.
14	65—1 —2	Effect of liming soils ...	Wheat (haura, Nagpur.) do. ...	do. ... do. ...	Wheat (haura, Nagpur.) do. ...	Caustic lime ... *Nil.* ...	*Nil.* ... do. ...	*Nil.* ... do. ...	1890.	No. 1 was limed in 1890-91, and another application of lime to be made after 12 years. The crops to be in rotation and manures, especially organic ones, to be applied to both the plots equally occasionally.
15	68—1 —2 —3	Effect on wheat of manuring with saltpetre in different rates per acre.	Wheat (haura, Nagpur.) do. ... do. ...	Wheat (haura, Nagpur.) do. ... do. ...	Wheat (haura, Nagpur) do. ... do. ...	do. ... Saltpetre drilled in with seed, 240 lbs. per acre. Saltpetre drilled in with seed, 80 lbs. per acre.	do. ... Saltpetre drilled in with seed, 240 lbs. per acre. Saltpetre drilled in with seed, 80 lbs. per acre.	do. ... Saltpetre drilled in with seed, 240 lbs. per acre. Saltpetre drilled in with seed, 80 lbs. per acre.	1894.	To be irrigated. Cropping and treatment similar every year.

Annexure D.—(*Concld.*)

Serial No. of experiment.	No. of field.	Purpose of experiment.	Crop. 1st year.	Crop. 2nd year.	Crop. 3rd year.	Special treatment. 1st year.	Special treatment. 2nd year.	Special treatment. 3rd year.	Year (commencing June) in which experiment started.	Remarks.
16	A—1	Effect on wheat grown continuously of different kinds of manures applied year after year without irrigation.	Wheat (haura, Nagpur.)	Wheat (haura, Nagpur.)	Wheat (haura, Nagpur.)	Saltpetre ...	Same as in first year.	Same as in first year.	1883.	Cropping and treatment similar every year. *Quantities per acre.* Saltpetre ... 240 lbs. Bone-dust ... 360 „ Cattle-dung ... 160 mds. Ashes of 160 mds. dung.
	—2		do. ...	do. ...	do. ...	Bone-dust ...				
	—3		do. ...	do. ...	do. ...	Saltpetre and bone-dust.				
	—4		do. ...	do. ...	do. ...	Cattle-dung ...				
	—5		do. ...	do. ...	do. ...	Dung and bone-dust.				
	—6		do. ...	do. ...	do. ...	Ashes of dung.				
	—7		do. ...	do. ...	do. ...	*Nil.* ...				
	—8		do. ...	do. ...	do. ...	*San* hemp ploughed in green.				
17	B—1	Effect on wheat grown continuously of different kinds of manures applied year after year with irrigation.	Wheat (haura, Nagpur.)	Wheat (haura, Nagpur.)	Wheat (haura, Nagpur.)	Saltpetre ...	Same as in first year.	Same as in first year.	1890.	To be irrigated. Cropping and treatment similar every year. *Quantities per acre*, as for Series A.
	—2		do. ...	do. ...	do. ...	Bone-dust ...				
	—3		do. ...	do. ...	do. ...	Saltpetre and bone-dust.				
	—4		do. ...	do. ...	do. ...	Cattle-dung ...				
	—5		do. ...	do. ...	do. ...	Dung and bone-dust.				
	—6		do. ...	do. ...	do. ...	Ashes of dung ...				
	—7		do. ...	do. ...	do. ...	*Nil.* ...				
	—8		do. ...	do. ...	do. ...	*San* hemp ploughed in green.				
18	Ville-1	Practical method of soil analysis by using chemical manures, as devised by M. Georges Ville.	Linseed (red) ...	Linseed (red) ...	Linseed (red) ...	Amm. Chlor. Cal Superphosp: Pot. Sulph.: Cal. Sulph.	Same as in first year.	Same as in first year.	1890.	Cropping and treatment similar every year. *Quantities per acre.* Ammonic Chloride ... 140 lbs. Calcic Superphosphate ... 180 „ Potasic Sulphate ... 90 „ Calcic sulphate ... 100 „
	—2		do. ...	do. ...	do. ...	As in I less Cal. Superphosphate.				
	—3		do. ...	do. ...	do. ...	As in I less Amm. Chlor.				
	—4		do. ...	do. ...	do. ...	No manure ...				
	—5		do. ...	do. ...	do. ...	As in I less Potassic Sulphate.				
	—6		do. ...	do. ...	do. ...	As in I less Calcic Sulphate.				

Annexure E.

Note on the Nagpur Experimental Farm.

This Experimental Farm was established in 1883, in which year the former Model Farm was given up, and the present site selected in its stead. The land is close to Nagpur, and is conveniently situated either for inspection by the Director of Agriculture or for visits which may be paid by surrounding cultivators. It consists of a fairly level piece of land of about 90 acres in extent, and is probably as well suited to the purpose as any that could be obtained. The soil is all "black cotton soil."

When established.

Site.

2. The description of work undertaken at the new farm has been of a much more precise nature than at the former one; and an advantage has doubtless been gained by the change.

Objects.

The experimental work, may be classed under the heads, *(a)* testing the value of new crops; *(b)* testing the value of different manures; *(c)* the applicability of new implements to Indian Agriculture; *(d)* methods of cultivation and rotation of crops.

3. But in addition to this, which may be classed under the head of experimental work proper, three other matters have been taken in hand by the Director of Agriculture, namely the better utilization of night-soil for agricultural purposes, an Agricultural School has been established, and more recently an area has been taken up for the growth of firewood. Although these may be considered as distinct from the farm, the two former are carried on at the same site and are included by the Director in his Annual Reports of the Farm. I deem it proper therefore to refer to them also in this note.

4. The Farm, with its accompaniments, the School and disposal of night-soil are in the charge of the Commissioner of Settlements and Agriculture. The details of the work are placed in the hands of a Superintendent, who is also placed in charge of the School.

Management.

The details, whether of labour or of weights of crops, are primarily entered in rough note-books (which are not destroyed), and from these, they are entered in the "Cultivation Book". In this a pair of pages are reserved for each plot, and the details of labour and outturn with any remarks are herein entered.

Farm Books.

The results contained in this book are further transferred to the "Field History Book" in which the crop of each plot, its treatment and outturn, &c., are entered consecutively for the whole series of years, thus enabling one at a glance to see what the treatment of any plot has been in the past. The results of the experiments are annually published in a separate report.

Under the head of management I do not think that I can suggest any improvement. If the Farm always has such capable guidance as that which Mr. Fuller has bestowed upon it in the past, and such an energetic and capable Superintendent as the present one, it may safely be assumed that the work will be of a useful nature.

The method of keeping the Farm Records is in every way suitable.

(*a*) *New Crops.*

5. I now pass to a brief description of the experiments which I will take in the order above (paragraph 2) indicated. Among new crops which have been grown experimentally on the Farm may be mentioned, American cottons and cottons from other parts of India, American Maize, *Sorghum Saccharatum*, Wheats, Juar and Guinea grass.

The experiments.

Of these the following may be referred to.

6. *Sorghum Saccharatum* was grown in 1883, 1885 and 1889. This plant has been strongly recommended in America as an economic sugar producer. It occupies the land for 5 or 6 months only, and requires generally no artificial irrigation. It is therefore a much cheaper one to grow than sugar-cane. The crops of 1885 and 1889 were seasonably harvested; and the juice was very carefully evaporated in a Cook's evaporator, but very little crystalisable sugar was obtained.

7. Three varieties of American Maize were grown experimentally in 1883, two of which, "Golden Dent" and "Maryland White Corn," were considered to deserve an extended trial. They were cultivated in 1884 and 1885, and some of the cultivators in the neighbourhood have continued to grow them. The Golden Dent variety appears to have succeeded best.

Maize.

8. Among these, Upland Georgian, New Orleans, Lousiana prolific, and Sea Island, have been grown experimentally, but they have not given much promise of success, excepting the Upland Georgian. This variety has been grown each year since the farm was established, and is still cultivated.

Exotic cottons.

The outturns have been as follows.—

The figures are in terms of lbs. of cleaned cotton per acre.

		Upland Georgian.	Bani.	Jari.	
1883	Manured ..	186			
	Unmanured ...	40	58	31	
1884	Manured ...	41	26	Very heavy monsoon rains.	
	Unmanured ...	8	12		
1885	Manured ...	103			
	Unmanured ...	100			
1886	Manured ...	174			
	Unmanured ...	85			
1887	Manured ...	65	Heavy rain.		
	Unmanured ...	36			
1888	Manured ...	138			
	Unmanured ...	124			
1889	Manured ...	105	160		
	Unmanured ...	79			
1890	Manured ...	84	90	156	
	Unmanured				
1891	Manured ..	58	47	64	
	Unmanured				
1892	Manured ...	86	94	110	
	Unmanured				

This statement shows the outturn of the Upland Georgian, and the two local varieties which have been grown on neighbouring plots of land for the sake of comparison.

9. The Upland Georgian variety has been valued by cotton-spinners on several occasions. The crop of 1883 was valued at Rs. 78 per 340 lbs., as against Rs. 72 for the bani and Rs. 58 for the jari; that grown in 1885 was considered superior to the Hinganghat variety; in 1890 the valuations were Rs. 79 for Upland Georgian, Rs. 70 for bani and Rs. 50 for jari per *bojha* of 345 lbs; in 1891 the valuations were Rs. 79, Rs. 74 and Rs. 50, respectively; and in 1892 the Upland Georgian and bani were valued at Rs. 100, the jari at Rs. 88 per *bojha* of 345 lbs.

10. Seed of this variety (Upland Georgian) was distributed to some of the cultivators of the Wardha district in 1885, in 1886, 1887, 1888 and in 1889. At first the results were hopeful, and in 1889 the Deputy Commissioner was able to report that "they (the ryots) are unanimous in saying that the cotton is whiter than the ordinary country kind, and yields a larger proportion of cleaned cotton," but it appears from the report of 1889-90 (page 4) that the cultivators had mixed up the seed with the indigenous varieties, thus preventing definite information from being gained as to the outturn, &c.

11. Of the varieties locally culltivated, the bani and jari have been grown a number of times, and their average outturns of clean cotton per acre are given in the above statement (paragraph 8).

Local varieties of cotton.

It will be seen that the outturn of the jari variety is higher than that of either bani or Upland Georgian.

After valuation of the crops in 1891, the Superintendent of the Farm draws the following conclusion.

> "Taking the value realised per acre into account, the difference, though not so very great, is more than sufficient to account for the superior varieties being driven out of the market, jari has yielded 22 per cent, more in value than bani, and 18 per cent more than Upland Georgian. It should be noticed here that though Upland Georgian has given less in outturn, it has realised better value than bani. I am informed on very good authority that the present price of jari is more than its intrinsic worth, owing to its being largely used for adulterating superior varieties. If means be adopted to check this fraudulent mixing of inferior with good varieties, it would then be interesting to see whether the better varieties could not hold their own against jari, in spite of the latter's larger outturn. I am informed that during the year under report jari was grown to such a large extent at the expense of bani, that its price fell to something of its real value, and cultivators who had grown bani realised better profits than those who had put their faith in jari alone."

And again in the following year the position of the jari variety is thus stated (*vide* page 4 of the Farm Report, 1891-92).

"The commonly grown local variety, known as jari, gave the largest outturn, but its produce was valued by the Manager of the Empress Mills at only Rs. 50 per *bojha* of 345 lbs., as against Rs. 79 for the American varieties, and Rs. 74 for local bani. Having regard to quality as well as to quantity of outturn, the Upland Georgian and the American variety known as Allen show best. In the previous year local jari more than compensated for the low value of its produce by the quantity of its yield. This was not the case in 1891, but the outturns are, all through, too small to warrant definite conclusions. The experiments of both years show clearly that local jari is the most paying kind for the ryot, unless he is allowed by the middlemen to obtain the full value of higher class cottons, which I have been assured is rarely the case."

And a similar expression of opinion is found at page 12 of the report for 1892-93.

"In both experiments the jari variety shows best, its larger outturn compensating for its lower value. The value of the bani crop is, however, but very little behind. Jari is the short-stapled cotton commonly sown in the neighbourhood; whereas bani, though also a local variety, is of much finer quality. Jari produce is of comparatively low value, being priced at Rs. 88 per *bojha* of 345 lbs., whereas the other varieties are all valued at Rs. 100 by the Manager of the Empress Mills."

Pedigree wheat.

12. In 1886-1887 it was decided to endeavour to raise a stock of pedigree wheat. The local varieties called "haura," (hard-white), and "pissi" (soft-white) and "katha" (hard-red) were sown on some good land, and at harvest the best and largest ears selected and retained for sowing in the next cold weather. In this way it is hoped that the quality of the grain will improve. There seems to be some ground for believing that the experiment may be fruitful.

The report of 1889-1890 contains the following statement :—

	Average weight of one Paili.				Market value of one Khandi.			
	Pedigree.		Ordinary.		Pedigree.		Ordinary.	
	lbs.	oz.	lbs.	oz.	Rs. a. p.		Rs. a. p.	
Haura	2	10¾	2	9¾	12	4 0	11	14 0
Pissi	2	10¾	2	9¾	12	0 0	11	8 0
Katha	2	10¾	2	10	11	8 0	11	4 0

13. It is probable that more immediate good will be done at Experimental Farms in the matter of improving the quality of seed than in other directions, and this part of the work may well be pushed. Different varieties of cotton, including Upland Georgian, are still being grown, but the annual distribution of Upland Georgian seed has ceased.

The American Maize seed was appreciated by the Kachis, but judging by some cobs which I saw in their village, it has deteriorated, probably by cross fertilisation with small varieties. Some of the American sorts might be annually grown for seed and the seed sold.

The maize usually cultivated in the Jaunpur district, North-Western Provinces, is also a superior sort, and might be likewise introduced on the Nagpur Farm.

Another crop which it might be worth while to grow is the large description of bajri *Pennisetum typhoideum*, which is cultivated in Gujrat.

The experiment with pedigree wheat is being continued, as also are the white and brown varieties of linseed.

In all such experiments, specimens of original, as well as samples of each year's crop, should be kept for future comparison. Moreover, it would be well to obtain new stocks of seed from the original source every few years.

(*b*) *The comparative value of different manures.*

14. With the exception of the manures employed in one experiment (the Ville Series) the manures employed have all been of a very "practical" description. Bone-dust, saltpetre, dung and box-dung, poudrette, green manuring with hemp, Tarota, *Psoralea corylifolia*, have been experimented with for a variety of crops. Whilst many of the experiments have been, however, of a very temporary description, there are a few which deserve a careful scrutiny, since they have been persevered with through a series of years.

The Ville Series.

15. What is called the "Ville Series" of Plots, consists of series of six, one of which is manured with a "complete" manure, consisting of ammonium chloride, Superphosphate of Lime, Sulphate of Potash, Sulphate of Lime, and thus contains all those essential elements of plant-food which are generally present in the soil in small proportion, and frequently in deficient proportion. Four of the other plots also receive certain of the abovenamed manurial substances, one of the essential plant-foods being eliminated from the mixture for each plot. Thus Plot 2 receives no Phosphate, and here the Superhosphate of Lime is excluded, whilst the Ammonium Chloride, Sulphate of Potash and Sulphate of Lime are employed.

The Ville Series.

Plot 3 again receives no Nitrogen, and therefore the Ammonium Chloride is omitted from the mixture. There is also a plot to which no manure is added.*

16. The experiment was originally recommended as a method of determining whether a particular soil was deficient in some one of the several of these plant-foods.

Later teachings of experimental agriculture have shown that a certain plant-food may affect two crops in the same soil quite differently. No better illustration of this fact could be given than the different effects of Nitrogenous and Phosphatic manures on the cereal and root crops (in Europe).

The cereal crops are particularly influenced by the application of a Nitrogenous manure, whilst the root crops are especially improved by a Phosphatic manure, and these effects are noticeable whether the soil be a clayey or a sandy one. At the Experimental Farms at Cawnpur, Dumraon and Burdwan a corresponding result has been obtained in the case of cereal crops, these having responded particularly to a Nitrogenous manure, whilst bones (Phosphates) have had little effect in increasing the outturn. Roots have not yet been very successfully grown.

17. In the case of the experiments made at the Nagpur Farm wheat was the crop grown, and one might have anticipated that the effects of the Nitrogenous manure, Ammonic Chloride, would have been demonstrated. Although the results have not been very concordant, they indicate that the effect of Nitrogen on the wheat crop in black soil is considerably greater than that of the other plant-foods. The figures in the following statement are the average outturns of wheat obtained for the five years 1883-84 to 1887-88. Since then the plots have been altered twice, with the object of obtaining more regular results.

I	II	III	IV	V	VI
Ammonic Chloride, Superphosphate, Potassic Sulphate and Calcic Sulphate.	Ammonic Chloride, Potassic Sulphate, Calcic Sulphate (no Phosphat.).	Superphosphate, Potassic Sulphate, Calcic Sulphate (no Nitrogen).	No Manure.	Ammonic Chloride, Superphosphate, Calcic Sulphate (no Potash).	Ammonic Chloride, Superphosphate, Potassic Sulphate.
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1,514	1,537	1,198	1,039	1,284	1,213

The manures would, from the ryots' point of view, be called unpractical, but as an illustration for the benefit of the students at the Agricultural School, it should prove valuable.

The "A," "B" and "C" series of plots.

18. Perhaps the most practical and at the same time the most uniformly made experiments with manures at this Farm have been carried out on three series of plots, named respectively "A," "B" and "C."

Each series consists of eight plots, to six of which Nitrate of Potash (Saltpetre); Bone-dust; Saltpetre and Bone-dust; Cattle-dung; Cattle-dung and Bone-dust; and ashes of Cattle-dung are applied as manures—on a seventh plot a crop of "san hemp" *crotolaria juncia* is grown in the monsoon, and then cut down and ploughed in as a "green manure." Lastly, a plot is left unmanured.

* NOTE.—On Plot 6 the Calcic Sulphate was omitted, the idea being to eliminate this substance from the mixture on this plot. But since the Superphosphate employed contained probably nearly as much Calcic Sulphate as the Gypsum which was applied to all other plots, the effect of omitting the Gypsum on this plot was really only a *reduction* of the amount of this substance in the manure, and not its total elimination.

"A" Series was commenced in 1884 and has been carried out regularly ever since There are thus nine years' results recorded. Wheat is the crop grown, and no artificial irrigation is employed.

"C" Series was a duplicate of "A," and was continued from 1884-85 until 1889-90, and they provide therefore the results of six years. Wheat was here also the crop cultivated and without irrigation.

"B" Series of plots has been manured in a similar manner since 1885-86, but the crops cultivated have varied. Since 1890-91 wheat has been the crop grown, but irrigation has been introduced into the experiment. Together, therefore, these three series of plots should provide an index as to the comparative value of these manures for the wheat crop. Had it not been for the attacks of rust which have interfered continuously with so many of the experiments at Nagpur, this result would doubtless have been attained, but the effect of this disease has been to interfere most seriously with the experiments, and only general deductions can be drawn.

19. I have recently compared the results obtained at several of the Experimental Farms regarding the value of cattle-dung and "green manure" for cereal crops, and have put the information thus attainable, together in the form of a note, and I submit a copy of the same with this.

It will be unnecessary for me therefore again to enter into the details of the results obtained with cattle-dung.

Green manuring.

20. This term is applied to a practice which is not unknown in different parts of India, though it is not generally employed. It consists in growing a crop, generally a leguminous one, and in ploughing it in whilst still green. This acts as a manure for the following crop.

The crops which have been thus utilized at Nagpur are san hemp *Crotolaria Juncia*, "tarota" *Cassia auriculata*, and *psoralea corylifolia*.

The crops for which this system of manuring has been applied were wheat, linseed and more recently cotton. All the experiments with manures for wheat and linseed have been vitiated more or less by attacks of either rust or "talap," and consequently for this system of manuring the data obtained are not as uniform as might have been wished. Moreover, on unirrigated land, it is necessary not only to grow the green crop, but likewise to have sufficient additional rain after it is ploughed in, to cause its decomposition. In some years there has been a deficiency of late rains, and the green crop has remained more or less undecomposed in the soil.

In the 2nd part of the note on the value of Cattle-dung, I have tabulated the outturn of wheat obtained at Nagpur by ploughing in san hemp.

The results there embodied belong to the "A," "B" and "C" series of experiments, which have been carried out systematically during a series of years. Results obtained in other experiments have been on the whole more favourable to the method, but the previous treatment of the land was not regular, and the figures are consequently not sufficiently reliable for basing calculations upon. The method is still being tested in several of the present experiments, and more reliable information may be gained in the course of a few years.

21. Since this means of manuring land entails the provision of both seed and labour, it is necessary to estimate, as far as may be, its probable cost to the cultivator.

In my note (already referred to) I have (paragraph 14) explained that I think it a method readily within the means of an ordinary cultivator. In the report of the Nagpur Farm, I find estimates of its cost given. Two of these may be quoted.

The one will be found at page 7 of the report for 1886-87, and amounts to Rs. 3-13-0 per acre; the other is stated at page 29 of the report for 1890-91, and amounts to Rs. 9-8-6 per acre.

The former rate would show the method to be within the means of the cultivator; the latter would show it to be too expensive.

At Cawnpur the cost is stated at Rs. 2 per acre.

It always appears to me to be an extremely difficult thing to fix money values of this nature. If a ryot has to pay for anything in silver, the valuations may be considered legitimate, but where it is merely a matter which will occasion him a little extra labour, I think it misleading to pit against it the cost entailed to Government on an Experimental Farm. This process of green manuring would probably cost the cultivator no ready money at all—the seed could be readily grown on a small plot, and the labour amounts to about an extra ploughing, *plus* the time required to cut down the crop. The above estimates have reference to the san hemp crop. *Psoralia corylifolia* does not require to be cut down and may be ploughed in straight away.

Saltpetre.

22. The value of saltpetre as a nitrogenous manure for almost all crops has been recognised for a long time in Europe, and although it is generally classed as an "artificial" manure, it very properly has found a place among the experiments at the Nagpur Farm. I give below the annual

outturns of wheat in lbs. per acre of the plots Nos. 1 and 7 of the "A" Series, of which No. 1 received annually 240 lbs. of saltpetre per acre, whilst No. 7 is the "no manure" plot:—

No.	1884-85.	1885-86.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.	1891-92.	1892-93.
1 Saltpetre 240 lbs. per acre ...	1,555	990	1,610	1,470	610	987	1,227	612	420
7 No manure	1,055	763	1,060	760	525	887	515	450	230

Similar results were obtained on the corresponding plots of the "C" series.

Its value as a manure for wheat is here again demonstrated. The experiments which have been made at the Cawnpur Farm for 12 years with this substance as a manure for wheat and maize have given a like result, and it may therefore be confidently stated to be a valuable manure for cereals in India as in Europe. Its price is unfortunately high, about Rs. 10 per maund, for the pure saltpetre. It may not be necessary to apply so much as 3 maunds per acre, and in another experiment at Nagpur only 1 maund is being applied. For cereals in England it is employed at the rate of 2 to 3 cwts. per acre.

Bone-dust.

23. Bones, finely crushed, have been applied as manure for several of the crops on the Farm every year, but the only systematic experiment which has been made with it, is on plot 2 of the "A" series, in which wheat is the crop cultivated.

The following statement shows the results:—

	1884-85.	1885-86.	1886-87	1887-88	1888-89.	1889-90.	1890-91.	1891-92.	1892-93.
Plot 2 Bone-dust at 360 lbs. per acre. ...	1,067	635	1,340	948	695	845	685	567	267
„ 7 No manure. ...	1,055	763	1,060	760	525	887	515	450	230

Thus it will be seen that this manure has generally produced an increase of crop.

The cost of collecting bones for the Farm amounts to 4 annas per maund, and for crushing to 12 annas per maund: the 360 lbs. thus costing Rs. 3-6-0.

24. The experiments with different manures have been practical and useful.

I have mentioned in paragraph 17 that the Ville Series is useful, more particularly for the students. Mr. Joshi has suggested to me the desirability of growing linseed instead of wheat in this experiment, and I think the suggestion might well be carried out. It would introduce a new "natural order" of plants into the experiment.

The "A" and "B" series are very properly being continued. It might be advisable to start a somewhat similar series of plots for linseed. If this were done, I would recommend that on plots 3 and 5, green crops should be ploughed in, instead of the bone-dust and saltpetre, and bone-dust and dung, which are at present applied in experiments "A" and "B"

The two plots Nos. 3 and 5 might then be manured with "tarota" and *psoralia corylifolia* in the new experiment, and we should thus have three plots—"green manured." Further than this I would not recommened any alterations under this section of the experimental work.

(*c*) *Implements.*

Implements.

25. A number of implements of a more or less novel character have been tested in different years. Among these the following may be mentioned:—

"Cook's sugar-juice evaporator," a shallow vessel which has worked as well at Nagpur as it has done at Cawnpur. It is intended for the manufacture of crystallized sugar and is unfitted for the making of ghur. It can be made locally for about Rs. 40.

Threshing machines.

Several threshing machines, including Mayfurth's Hand-thresher, Hubner's little giant bullock-power thresher and cleaner, Ransome's bullock-power thresher, have been tested for a number of years, and are all far cleaner and more expeditious than the usual method of treading the grain out by bullocks.

It is difficult to make a comparison of the cost of these machines with that of treading out the corn by bullocks, but even if no cost be allowed for the bullocks, it is doubtful whether these machines are not cheaper than treading out. Moreover, the grain comes out much cleaner and with better appearance. Dell's Hand-winnower is also frequently borrowed by the cultivators.

Ploughs.

Several descriptions of the iron plough have been tested, and the "Swedish" plough has shown itself useful. It is used by the Kachi cultivators in the neighbourhood. Its draught is no greater than that of the country "nagar," and it does the work in half the time. Some have been sold.

Seed drills.

Mr. Joshi has replaced the bamboo tubes of the ordinary native drill, with iron ones, at the expense of a few annas. These have been found to work well for most seed, but they proved useless for cotton seed, which, even after treatment with cow-dung, was caught in the iron tube. As it requires a woman for each tube of the native cotton drill, it would save a lot of labour if tubes could be

introduced which would allow the cotton seed to pass freely, in which case the seed could be "served" by one person. With this object I have suggested to Mr. Joshi that if the iron tubes were internally coated with paint and then varnished, their surfaces would be so smooth that the seed might pass.

I have also suggested that if a "marker" could be added to the native drill to draw a line, down which the drill should pass on its return journey, the distance between the third and fourth lines (in the case of a three row drill) would be uniform, and weeding with the "dhundia" or the "dhaura" would be much simplified.

The "marker" would act in the same way as the one usually employed when preparing the land for sowing potatoes at home.

(d) Methods of cultivation.

26. Under this heading come principally "rotation" of crops and mixture of crops. This subject has only been taken up systematically during the last few years, and there has not been sufficient time to provide reliable data to draw conclusions.

The experiments have been instituted, in order to determine, if possible, the *raison dëtre* of a number of the cultivator's practices.

One method of cultivation distinct from the above, is the practice of embanking the land, which is general in the Northern districts of the Provinces. It has been tried for a number of years at Nagpur for the wheat crop, but proved an entire failure here.

The effect of trees on the neighbouring crops.

27. Another experiment instituted by Mr. Fuller is well worthy of note. It is a matter of common observation that crops frequently fail partially or wholly to grow in the immediate neighbourhood of trees. The explanation has been that the "shade" prevents vigorous growth, or again, it has been stated that the drippings of rain water from the trees cause the damage.

It occurred to Mr. Fuller that it might be the surface roots of trees which were the real source of harm; that especially during the period of active growth they drained the soil of its available plant-food to the detriment of the crops it was desired to cultivate. In order to answer this question, a trench some two feet deep was dug along side a row of mango trees and bamboos, which had (apparently) prevented healthy growth for some distance away from them. Their surface roots were thus cut through, and with the immediate result that crops could be grown right up to the edge of the trench. I believe that Mr. Fuller has thus answered a question which affects agriculture not only in India but in other parts of the world likewise.

The Sewage Farm.

28. In 1882 a number of Kachis from the Cawnpore district were imported to show the cultivators around Nagpur, the manurial value of night-soil. They were provided with land close to the farm, and a portion of the town night-soil and road-sweepings were deposited in pits, measuring $10' \times 4' \times 4'$ deep. The pits are partially filled with the night-soil and sweepings, and then earth is spread over the top. It is found that at the end of 12 months a fairly odourless poudrette results.

Irrigation water is provided from a small channel from the Ambajhari Reservoir.

The cultivator pays a rent of Rs. 20 per acre, *plus* a water-rate of 8 annas for each watering. They cultivate 23 acres. The experiment has not only been successful in putting to its proper use some of the town night-soil and sweepings, but the neighbouring Kunbi cultivators have also commenced to use the poudrette.

29. In connection with this part of the work, it has occurred to me that the system, which has been adopted at the Allahabad Grass Farm for disposal of night-soil, might be tried experimentally at Nagpur also.

The method, as will appear from the following extract from the Allahabad Grass Farm Report for 1892-93, is extremely simple. It entails the temporary use of a much larger area of land than does the "pit" system at present practised at Nagpur, but if it works as well at other places as it has done at Allahabad, I feel sure there will be no difficulty in obtaining land for the purpose. It has the great advantage of not requiring that the material shall be moved after being once deposited, and it is doubtless also the case that the processes of oxidation proceed much more rapidly, than they do when the material is buried deep.

I saw some land recently (August) at Allahabad, which was being thus used, and although in the monsoon, the earth was almost odourless at the end of a week, I am told that in the dry weather there are hardly any odours at all from the land immediately after earth has been strewn over. The land should, I think, be allowed to be fallow for several months after depositing the night-soil, and it is also probable that the same land should only be manured in this manner once in 5 or 10 years. Experience, however, with the method is required before a definite opinion can be formed on these points.

(Extract from letter from the Principal Medical Officer, Allahabad District.)

"At the Allahabad Grass Farm the following system, devised by Conductor Meagher, has been found to answer best. For the contents of each filth cart, a rectangular space 14′ × 5′ is taken and the top soil scraped off to the edges to a depth of 3″. The soil at the bottom of the space is then loosened and pulverised to a depth of 6″ or 7″

"The shallow trench having been thus prepared, the contents of the filth carts (Crowley pattern) are tipped into it. If the bottom soil has been well pulverised, the fluid portion soaks into it quickly, leaving a thin stratum of the solids on the top, which is now covered over with the 3″ of earth first removed. The shallow trenches are prepared in succession, leaving a space of about 4″ between them."

The Telenkheri Fuel Reserve.

30. An open piece of land on the top of a low (basalt) hill at Telenkheri has been recently taken up by the Commissioner of Settlements and Agriculture with a view of converting it into a fuel reserve. Babul, khair, teak, bamboo, and sal have been sown in lines at several places within the area, and the babul and "khair" are especially giving promise of success. One portion of the land was planted with "ber" by the Forest Department some years ago.

The soil is doubtless thin and very stony, and this will probably form a stumbling block to the work.

But although difficulties will be encountered in growing trees on such poor soil, the experiment should be prosecuted and given a fair trial.

In the meantime the cattle are a source of considerable mischief, and I found numbers of young trees nibbled off.

Mr. Joshi, the Farm Superintendent, has prosecuted two of the owners, but the only satisfaction obtained is a fine of Rs. 2 and, as he said to me, "These g'wallas do not mind such a punishment. It represents the sum they pay for the food of their cattle for a long time."

So long as open grazing is permitted, so long will it be futile to attempt to provide firewood, and the owners of cattle, who deliberately turn their cattle loose at night to graze where they please, should be punished in a manner commensurate with the damage they cause. I see it mentioned in one of the Farm Reports that they go at night into the farm fields, and I am informed that the same takes place in the case of cultivators' land.

So far as the Telenkheri Reserve is concerned, I would recommend that a fence of "prickly pear" be put down as fast as may be possible. It would, I am informed, be very expensive to hedge in the whole area, and that being the case, I would suggest that the areas on which trees have been actually planted might be first enclosed.

31. I do not place so much value on this attempt to establish a fuel reserve at Nagpur, merely for the purpose of providing Nagpur with fuel. I value it more because of the fact that at present we are almost without data, as to the amount of fuel which may be obtained off a given area, and we are totally without information as to the ryots' requirements in the way of wood. We are also equally ignorant as to the most suitable trees to grow for the purpose. It is for these reasons that I think it especially important to establish fuel reserves wherever the necessary supervision can be provided, and I hope that though the difficulties may be great at Telenkheri, the experiment may be pushed for some years.

The Agricultural School.

32. This was established in 1888 as a part of the Chief Commissioner's scheme for Technical Education, and has since continued to work satisfactorily.

The number of students has varied somewhat, but, as a rule, about a score have been in attendance.

The course of study extends over two years, and includes the following subjects :—

Chemistry, Botany, Geology, the Principles of Agriculture, Practical Agriculture in the Field, Surveying and Veterinary Surgery (Practical).

A Vernacular class for masters of the Primary Schools was established in 1891, for which a six months' course of instruction is provided.

33. Dr. Voelcker visited the school in 1890 and his remarks upon it will be found at page 26 of the Report for 1890-91 and also paragraph 524 of his Report on Indian Agriculture.

Mr. C. Benson, Assistant Director of Agriculture, Madras, also visited the school in 1890, and his criticism of it will be found at page 28 of the Farm Report of 1890-91. I entirely agree with both these gentlemen in thinking that the school is doing good. The course of education is not too extensive nor too advanced, and I found the students quite able to answer most of the questions I put to them. The practical work both in Agriculture, Surveying and Veterinary Surgery is an undoubted advantage.

34. Regarding the "two years' course" the only disappointment appears to me to be that only a portion of the students who have been adjudged qualified in the final examination are able to find employment.

It is acknowledged by Mr. Fuller (paragraph 8 of his review of the work of the Farm for 1892-93) that the students attend with the express idea of getting into Government employ.

This would appear to be an old story in India, and whilst one might wish it were otherwise, it may also be fairly noted that the majority of those who go to Agricultural Colleges at home, or, on the continent do so with the express purpose of obtaining employment. Some are the sons of landed proprietors, but there is a large proportion who are drafted into Surveyors' and Land Agents' offices. Thus to a certain extent the students may be sympathised with in hoping to obtain Government employment, since no other openings are at present available.

Moreover, as Dr. Voelcker in paragraph 506 of his Report says, in reference to this part of the subject, "I do not think there is much likelihood of a change, and therefore it is "better to provide for things as we find them and not as they might be."

On enquiry I found that some of the passed students had obtained employment in the Revenue Department, but that they had not been employed in the Education Department, and only one had been employed on an estate.

It occurs to me that they might be found useful in both these directions.

35. In reference to the former—namely the Education Department, I think that the best way in which their services might be utilised would be to make them peripatetic teachers of the subjects, I will presently specify for a number of schools alloting, say five or six to each, and thus employing them in this special work entirely.

I make the suggestion because I fear that if they have to teach a very little agriculture and a great deal of something else, the agriculture would soon become a secondary matter with them, they would become "rusty" in it and finally get out of it altogether. The scheme would thus end in failure.

There is also another thing which I would suggest, if the plan were considered workable, and that is that those who were thus drafted into the Education Department, should not be allowed to cease all connection with the Agricultural School at Nagpur, but that they should attend it for a certain portion of each year for, say, the first five years after entering the Education Department.

The course of education there is only a two-years' one, and I feel sure that they would do very much better by having to thus constantly for a series of years, revise the teachings of that course, instead of getting "rusty" in those portions of it which they may not be called upon to teach in the schools.

The subjects which I would suggest as suitable for the schools are (1) Principles of Agriculture, (2) Structural Botany (with especial reference to the Farm crops of the immediate neighbourhood), (3) Entomology, with special reference to the insects of the neighbourhood, (4) Surveying. I leave out Chemistry purposely. I do not think that any good can be done by teaching it, without a proper laboratory and a larger amount of time than probably could be allotted to Agriculture. If, however, these desiderata could be provided, it would be well to permit its inclusion in the syllabus. All the abovenamed four subjects might and should be taught practically, and the examination should be such as to show that this had been properly carried out.

36. In making this proposal I do not wish to suggest the discontinuance of the six months' Vernacular class for teachers, which is already in existence at the Nagpur School. Not in India but likewise at home, our experience in the teaching of the Principles of Agriculture in Elementary Schools is extremely limited, and I do not think we can consider any scheme which might be proposed, in any other light than that of an experiment. Therefore by no means interrupt this one of sending the ordinary village schoolmasters to Nagpur; let it be continued until some definite conclusion as to its merits has been arrived at. Personally I have a doubt as to its success, and it is for this reason that I make the proposal of testing the usefulness of the "two-years'" students of the Nagpur School also for Agricultural Education.

I would not propose any large scheme, but would suggest that two or three such appointments be created each year for about ten years, and the results carefully noted.

37. The other direction in which I think these students might be employed is on estates. Cannot they be found useful as assistants to those who have charge of Court of Ward Estates? Whilst I am well aware that it is difficult to teach the ryot his business, I am also of the opinion that there is considerable room for the introduction of improvements on large estates. How often, for instance do we find good land cut up into ravines, simply because the land happens to be the common grazing ground and which zamindars think not worth protecting.

Or again, how often has Government spent money in the distribution of new seed to cultivators, with the only result that, when an answer was required as to its suitability or

success, it has been found that no reliable information could be obtained, or that the new seed had been deliberately mixed with other (local) seed.

In throwing out these as examples of possible improvements on zamindari estates, I do not wish it to be thought that I consider these youths capable of working independently of more experienced guidance. If they are to be successfully employed in this direction, I feel sure that they should act rather in the capacity of assistants to the manager of the estate. In the case of the Court of Wards' Estates, would they not be of service to the Deputy Commissioner in charge? It will I know be readily acknowledged that the Indian zamindar might manage his estate better than he does and introduce improvements; and I have no hesitation in saying that if they paid a fair attention to this duty, they would find well educated assistants quite a necessity. Their utility might in the meantime be demonstrated on Court of Wards' Estates.

The above are at least two directions in which I think these students might be provided with employment.

Conclusion.

38. I visited the Nagpur Farm on two occasions—namely March 12th to 17th, and August 28th to September 4th, 1894. I have commented on the several experiments which have been made and on the Agricultural Class, and I need only say here that I consider the work is being carried on in a thoroughly capable manner.

I would especially refer to the present Superintendent Mr. Joshi, who unquestionably takes a very great interest in all the various departments of the work, and he is moreover fully qualified for it. It was no small pleasure to me to be conducted over the farm by some one who did not require to turn either to his subordinates or to his note-books before he could answer the questions I put to him.

39. One subject only remains to be referred to, and that is the Annual Report. This has been made the subject of a communication, which I have recently, at the instance of the Secretary to the Government of India, addressed to the Commissioner of Settlements and Agriculture. I have taken the opportunity, which my visit to Nagpur has afforded, of discussing this matter with Mr. Craddock, the present Officiating Commissioner of Settlements and Agriculture, and I have explained to him that I think each year's report should not only be a report of that particular year's work, but that it should be kept up to date, and that one should be able to see the results of each of the previous year's results of any experiment without wading through all the different previous reports. It should also annually be drawn up in a uniform manner, and not re-arranged each year.

I am also of opinion, as was Dr. Voelcker, that the question of cost would be better left until the experiment has given some definite answer to the question raised.

J. WALTER LEATHER,

Agricultural Chemist to the Government of India.

September 1894.

Annexure F.

Note on the value of Indian Cattle-Dung.

The value of cattle-dung as manure has been tested at different Experimental Farms on a variety of crops and it has been usual to appraise its value, not only by an increase in outturn of those crops which the experiments may have shown to be due to it, but also to convert these results into money-value, deducting from the value of increased outturn, the estimated money-value of the dung. In addition to cattle-dung, various other manures have been employed on similar adjoining plots of land, and their effect registered in a similar manner. Among the latter may be named Crude saltpetre, bone-meal, and a green crop ploughed in. In the present note, I propose to review the effect of manuring land with cattle-dung and to set out what its value is, as deduced from certain experiments which have been made at the Experimental Farms situated at Cawnpur in the North-Western Provinces and Oudh, at Nagpur in the Central Provinces, and at Dumraon and Burdwan in Bengal.

The experiments at other farms have not yielded sufficiently accurate results to admit of their inclusion in this note.

2. In determining a value for cattle-dung one of three methods might be adopted—its effect may be compared (1) with the plots to which no manure has been applied, (2) with that of other manures, (3) or the results may be reduced to money-values. Against the last method there is much to be said, for in the first place money-values of commodities vary considerably from year to year and from locality to locality, and any valuation thus made is correct only for one set of prices, which may require altering tomorrow; whilst in the second place it is difficult to know how to place a money-value on cattle-dung at all, for the demand probably varies in every village.

As to the second method, a comparative value could only be made through the medium of the outturn of different crops. But this method might be adopted were it not for the fact that neither in the case of saltpetre nor in that of bone-meal have these manures been applied in quantities, bearing any relation to their chemical composition, or to that of cattle-dung. In the case of ploughing in a green crop the case is different, and I add a comparison of the effect of this method of manuring with that of dung.

For the primary determination of the value of cattle-dung I adopt the first method, namely that of comparing the amount of produce obtained from certain plots of land, some of which have been manured with cattle-dung for a series of years; whilst on certain other adjacent plots no manure has been applied.

3. The first consideration is as to which of many experiments made at the abovenamed farms, are sufficiently reliable to permit of their being used for the purpose in view. And here the fact is at once apparent that the results of the experiments do not possess anything approaching the regularity which has been attained at such experiment stations as those at Rothamsted or Woburn in England, and possibly constant change in the management has had something to do with this, but it is more than probable that the extreme nature of the seasons experienced in India is accountable for much of the irregularity in the outturns. An examination of the results shows that none of the series of experiments made admit of simple averages being struck, and that a much more detailed examination is necessary. Consequently no simple value for cattle-dung, even in terms of grain, can be arrived at. It will be only possible to exhibit its value within certain limits.

Another point must be noticed in preface, namely that only in one series of experiments (Nagpur) was the manurial effect of dung tested on dry land for a cold-weather crop. In the case of all the experiments at Cawnpur, Dumraon and Burdwan, the cold-weather crops were artificially irrigated.

4. The experiments which I propose to examine are (1) two series made at Cawnpur on the effect of manuring wheat and maize for 13 years, of which 12 years' results are available; a series of plots at Dumraon, on which wheat had been grown for six years; one series of plots at Burdwan, on which rice has been grown for four years; two series of plots at Nagpur, on which wheat has been grown *without* irrigation for 10 years (of which 9 years' results available) and for 6 years, respectively, and one series of plots at Nagpur on which wheat has been grown for four years *with* irrigation, of which three years' results are available.

I shall consider the experiments in the above order, because the first three named farms are all situated within the Gangettic plain, *i. e.*, an alluvial soil, whereas Nagpur is situated on the black "cotton" soil of Central India.

The Cawnpur Experiments.

5. Four series of plots have been set apart at Cawnpur for the purpose of testing different manures, and mixtures of manures, on the wheat and maize crops since 1881. On one of these series, called the "Standard," wheat has been grown every year; each plot is manured differently, but the same manure, in the same quantity is applied to the same plot each year, No. I plot receiving a dressing of 240 lbs. Crude saltpetre each year; No. II, 132 cwts. of cattle-dung each year and so on through the series. Another series of similar plots is set apart for the continuous growth of maize. This series includes the same number of plots and is called the "standard" maize series; they are manured with the same description of materials applied in like quantity as the "standard" wheat series.

There are in addition two other series of plots, called the "Duplicate" also manured annually with the same description of materials and in like quantity as the two "Standard" series. On these two series, however, wheat and maize are grown alternately. Maize occupying the land of one series in the monsoon, whilst wheat occupies the other series of plots in the following cold weather. Consequently, after the maize crop has been harvested from one Duplicate series, the land lies fallow for nearly 15 months, after which wheat is put into this series; whilst in the case of the other Duplicate series maize is put into it three months after the wheat has been harvested. These two Duplicate series not only bear alternate crops of wheat and maize, but enjoy fallows of three months and 15 months, respectively. The manuring as has already been explained is the same for all four series alike.

Whenever therefore maize is grown on either of these "Duplicate" series of plots, it is sown after a three months' fallow; whilst whenever wheat is sown on them, it is after a period of 15 months' fallow.

It is interesting to notice in passing the relative effects of this difference in length of fallow, and as will be seen from the subjoined statements of the outturns of grain on the plots mentioned, wherever differences occur between the outturn of a plot in the "Standard" series and of its fellow in the "Duplicate" series, there is generally (though not always) an increase in the case of wheat, whilst conversely there is usually a decrease in case of maize. A similar difference appears in the case of other plots of these four series, which are not named in the statement. This effect of fallow is what one would expect and coincides with the teachings of European experience.

6. As already mentioned in paragraph 3 it is not sufficient in examining the results of these experiments to strike a simple average, for the outturns vary in individual years too much. Where, in a series of figures, the individual members vary considerably from the arithmetic mean of the series, it appears to me to be a mistake to strike that mean as representing the average of the whole—this may only fairly be done when no great differences exist between different members of the series. It is necessary therefore to examine the results in greater details.

7. The plots which I have selected for consideration are, in the case of wheat, two plots, which have been left unmanured from the commencement, one in the "Standard," the other in the "Duplicate" series—two plots, one in the "Standard," the other in the "Duplicate" series, on which cattle-dung at a rate of 132 cwts. per acre has been applied annually; and two plots likewise in the "Standard" and "Duplicate" series respectively, on which 132 cwts. of cattle-dung *plus* 240 lbs. of Gypsum per acre has been applied annually.

These I include because in the first place the cattle-dung employed probably contained an amount of lime equal to that in the quantity of Gypsum employed, and therefore it has not been a case where one plot received no lime, whilst the other received some, but that both plots received some lime, the amount being about twice as large in the second as in the first case. But there is another reason why these plots, which received annual applications of dung and Gypsum may fairly be included, and that is, that there is no reason, so far as one knows, why Gypsum should produce any benefit to the crop. The soil of the farm contains a sufficiency of this element. The results themselves support these arguments, for no general increase in outturn can be traced to the Gypsum. I therefore include these two plots, and consider them as two, to which dung only has been applied, and credit any increase in outturn over the unmanured plot to the effect of the dung.

In addition to these, there is an unmanured plot in another series of experiments situated not far from the standard and duplicate plots, which I shall include, since it supports and adds to the value of the figures representing the outturn of the two unmanured plots abovementioned.

In Statement I the effect of dung on the wheat crop is shown.

Column 1 contains the list of years through which the experiment has been carried.

Column 2 gives the outturn of wheat in lbs. per acre on the unmanured plot of the Standard series.

Column 3 gives the corresponding outturn of wheat for the unmanured plot of the Duplicate series.

Column 4 contains the outturn of wheat obtained on the third unmanured plot.

Column 5 gives the average for each year of these three plots.

Column 6 gives the outturn of the "Standard" plot on which cattle-dung at the rate of 132 cwts. has been annually applied.

Column 7 gives the outturn for the corresponding plot of the "Duplicate" series.

Column 8 gives the outturn of the "Standard" plot on which cattle-dung, 132 cwts. and Gypsum 240 lbs. has been applied.

Column 9 gives the outturn of the corresponding plot in the "Duplicate" series.

Cawnpur Wheat.	Standard.	Duplicate.	Green manure series plot.	Average of columns 2, 3 and 4.	Standard dung 132 cwt.	Duplicate dung 132 cwt.	Standard dung and Carbonate Soda, 132 cwt.	Duplicate dung and Carbonate Soda, 132 cwt.	Average of four dung plots.	Increase due to dung.
1	2	3	4	4	6	7	8	9	10	11
1881-82 ...	777	771	...	774	918	738	882	594	783	9
1882-83 ...	1,065	999	...	1,032	1,713	1,623	1,761	1,886	1,745	713
1883-84 ...	1,031	2,281	1,515	1,609	1,428	3,031	1,364	3,004	2,206	597
1884-85	635	1,025	623	761	900	1,466	887	1,396	1,162	401
1885-86 ...	913	1,119	1,367	1,133	1,537	2,021	1,857	2,069	1,871	738
1886-87 ...	1,041	1,258	847	1,048	1,258	1,270	1,162	1,488	1,294	246
1887-88 ...	968	907	786	887	1,245	1,222	1,210	907	1,145	258
1888-89 ..	883	617	653	718	980	992	1,174	944	1,022	304
1889-90 ..	1,307	1,876	1,464	1,549	1,585	2,856	1,525	1,513	1,869	320
1890-91 ...	1,222	1,591	1,161	1,358	1,537	1,779	1,767	1,706	1,697	339
1891-92 ..	992	956	690	879	1,331	1,573	1,258	1,174	1,334	455
1892-93 ..	1,500	1,754	1,500	1,581	2,474	1,894	2,378	2,305	2,262	681

Column 10 gives the average of the four plots which have been manured with dung.

Column 11 gives the increase which may be attributed to 132 cwts. cattle-dung.

8. The figures require very little remark. There has been an increase each year from the commencement. The first year this amounted to only 9 lbs., but the results of the first year may be fairly excluded from the comparison; agricultural experimental plots generally require one or two years in which to eradicate the effects of previous treatment. Excluding therefore 1881-82, the increase has varied considerably, from 246 lbs. in 1886-87 to 738 in 1885-86. Approximately, it may be said that in two years the increase amounted to about 250 lbs.; in three years to about 300 lbs.; in two years to about 400 lbs.; in two years to about 600 lbs. and in two years to about 700 lbs. per acre.

9. Statement 2 contains the results obtained from the "Standard" and "Duplicate" series of plots on which maize has been annually grown since 1881-82. The statement in details is similar to Statement I.

The results of this experiment with maize vary within much greater limits than do those with wheat, and it is possible that it is not so suitable a crop to experiment with.

It is moreover much more liable to failure than wheat.

In two years 1887-88, 1888-89, the crop failed altogether, and in two other years 1885-86, 1886-87, the crop was much below the average on nearly all the plots of both series.

Cawnpur Maize.	Standard.	Duplicate.	Average of columns 2 & 3.	Standard dung.	Duplicate dung.	Standard dung and Carbonate Soda.	Duplicate dung and Carbonate Soda.	Average of columns 5, 6, 7 & 8.	Increase due to 132 cwts dung.
1	2	3	4	5	6	7	8	9	10
1881-82 ...	1,239	...	...	633	...	1,218	...	...	...
1882-83 ...	1,002	924	963	2,169	2,020	1,758	1,704	1,913	950
1883-84 ...	990	802	896	1,462	1,170	1,644	979	1,314	418
1884-85 ...	1,044	564	804	1,860	1,580	1,914	1,524	1,719	915
1885-86 ...	339	194	266	266	605	436	641	487	221
1886-87 ...	435	205	320	968	665	1,161	532	831	511
1887-88 ...	...	...	...	...	...	...	...	...	...
1888-89 ...	...	...	...	...	...	...	...	...	...
1889-90 ...	278	302	290	1,500	1,573	1,150	1,355	1,394	1,104
1890-91 ...	871	811	841	1,053	653	1,246	1,053	1,001	160
1891-92 ...	544	629	586	883	665	1,815	944	1,077	491
1892-93 ...	218	327	272	435	556	665	532	547	275

Excluding the first year and the two years of total failure, the increase due to cattle-dung varies from 160 lbs. to 1,104 lbs. per acre. Approximately, it may be said that in three years the increase was about 200 lbs.; in one year 400 lbs.; in two years 500 lbs.; in two years 900 lbs. and in one year 1,100 lbs. per acre.

Experiments at the Dumraon Farm.

10. No such extended series of experiments, as those carried out at Cawnpur, have been made at the Dumraon Farm. One series of plots has been manured during six years and a crop of wheat grown. This is the only experiment of a sufficiently reliable nature to admit of inclusion in this note. Statement III contains the results, the increase due to 131 cwts. of cattle-dung is contained in column 4. It will be seen that the increase due to the dung is much less than at the Cawnpur Farm. But the soil is a very heavy stiff clay, with no soil of a lighter nature below the surface soil, and this is probably a reason for poor average crops and small increase.

Dumraon Wheat.		Dung 180 maunds =131 cwts.	Increase due to dung.
1	2	3	4
1885-86 ...	1,158	1,514	+356
1886-87 ...	516	610	+94
1887-88 ...	672	908	+236
1888-89 ...	884	1,154	+270
1889-90 ...	910	1,386	+476
1890-91 ...	606	866	+260
1891-92 ...	...	...	...
1892-93 ...	...	...	...

This soil reminds one of the stiff clays in England, which could not be brought under profitable cultivation until improved cultivation appliances had been introduced.

The increase on this land has varied from 94 lbs. to 476 lbs.

Results obtained at the Burdwan Farm.

11. On a series of plots rice has been grown for the last four years at the Burdwan Farm, and on five of them no manure has been used at all. There is only one "dung plot."

The value of this series is somewhat modified by the fact that leguminous crops have been grown in the intermediate season of the year, and what effect this may have had on the succeeding rice crop it is hard to say. Statement IV contains the results. The figures in columns 2 to 9 represent lbs. of paddy (not cleaned rice) per acre.

Column 9 contains the increase of outturn obtained from the dunged plot over the *average* of the five unmanured plots.

As will be seen, there are wide differences between the results, but the experiments have not been conducted sufficiently long to admit of any definite conclusions being drawn.

Burdwan Paddy.	Plot (gram intervenes.)	Plot (wheat intervenes.)	Plot (peas intervene.)	Plot (Lintals intervene.)	Plot (Lintals intervene.)	Mean of colums 2, 3, 4, 5, & 6.	Dung150 maunds followed by peas.	Increase due to dung.
1	2	3	4	5	6	7	8	9
1889	1,126	738	1,320	914	860	991	1,620	+629
1890	1,434	1,722	1,184	1,140	1,476	1,391	1,330	—61
1891	850	860	1,570	1,768	1,886	1,387	3,996	+2,609
1892	1,968	1,22	1,230	1,260	1,476	1,531	3,690	+2,159

Results obtained at the Nagpur Farm.

12. At this farm there is one series of plots A, which has received dressings of certain manures since 1884, the crop grown being wheat, *unirrigated.* This series is still continued. Another series C, treated in a similar manner, was commenced in 1884 and continued until 1890. A third series, B, of plots, receiving similar dressings of similar manures for the wheat crop, but *irrigated,* was commenced in 1890 and still continued.

Statement V contains the results of the unmanured and the dunged plots of each of these series.

Nagpur.	A.		Increase or Decrease.	C.		Increase or Decrease.	B.		Increase or Decrease.
	Unmanured.	160 maunds dung = 115 cwts.		Unmanured.	Dung 160 maunds = 115 cwts.		Unmanured.	Dung 160 maunds = 115 cwts.	
1	2	3	4	5	6	7	8	9	10
1884-85 ...	1,055	1,003	—52	640	700	+60	..	...	...
1885-86 ...	763	515	—148	700	915	+215	...	...	...
1886-87 ...	1,060	1,550	+490	780	900	+120	...	...	...
1887-88 ...	760	1,138	+378	733	710	—23	...	...	...
1888-89 ...	525	350	—175	195	135	—60	...	...	...
1889-90 ...	887	1,012	+225	687	512	—175	...	...	...
1890-91 ...	515	937	+422	...	...	...	802	1,037	+235
1891-92 ...	450	602	+152	...	...	...	642	1,095	+453
1892-93 ...	230	312	+82	...	...	...	200	280	+80

It will be convenient to consider first the figures of the third experiment detailed in columns 8, 9, and 10, because they are for *irrigated* land. It will be seen that the increase due to cattle-dung, applied at the rate of 115 cwts. per acre, varies from 80 lbs. to 453 lbs. of wheat per acre. The columns 2, 3 and 4 contain the results of the A series, and columns 5, 6, and 7 contain those of the C series. The crop is not irrigated at all in either of these series. The outturns have varied enormously, and no deductions can be drawn from the results, This result, I believe, to be due in very great measure to the constant attacks of rust which interfere with many of the experiments at this Farm. In the majority of years there has been an increase due to cattle-dung.

13. Excluding these results obtained at Nagpur, it will be seen that a very distinct increase in outturn of grain is obtainable by means of an application of cattle-dung, amounting to several hundered pounds per acre.

But there is another factor which is of somewhat doubtful value, *viz.* the quantity of dung applied for these crops. No attempt has been made to determine how much cattle-dung is at a cultivator's disposal, and it would have enhanced the value of the experiments considerably if this had been determined and a dressing of manure applied, which would approximate fairly to that which a ryot would be able to apply. This estimation is now being commenced at several of the farms.

Regarding the composition of Indian cattle-dung a few analyses are available. Two are quoted in Dr. Voelcker's Report, Appendix D, and I tabulate these in the Statement annexed, to which are added analyses which I have made of some other samples. But these are useless by themselves; the weight per annum available is also requisite.

The value of cattle-dung compared with the effect of green-manuring.

14. At both the Cawnpur and the Nagpur Experimental Farms plots of land have been set apart to test the value of ploughing in a green crop in early autumn to act as manure for the cold-weather wheat crop.

At Cawnpur there are two series of such plots. In one case there are four plots, and in the other there are two plots on which green crops (indigo or san hemp, *crotolaria juncia*) are ploughed in towards the end of the monsoon. There is also an unmanured plot. These plots are all irrigated.

At Nagpur there are three series of plots which have been subjected to a like treatment; two series being unirrigated; whilst a third has received artificial irrigation. This method of manuring land for a cold-weather crop is not unknown to Indian agriculture, it being practised in certain parts of Bengal and Bombay Presidency, (*vide* Dr. Voelcker's Report, page 107). So far as the cost of the process is concerned, it may be estimated at the value of the seed employed and probably an extra ploughing. This does not amount to much, and it may be said to be a cheap method of manuring. The land must of course be lying otherwise fallow in the monsoon.

The Cawnpur Experiments.

15. The accompanying Statement VI is self explanatory. In the first set, columns 2—8, are four plots on which a green crop has been ploughed in for a series of years. Wheat, with irrigation, being the crop grown in the following cold weather. On one (column 2) a crop of indigo has been ploughed in; on a second (column 3) a crop of indigo has likewise been ploughed in, to which, however, has been added a dressing of 480 lbs. of Gypsum per acre; on a third (column 4) a crop of san hemp, *crotolaria juncia*, has been ploughed in; and on a fourth (column 5) a crop of san hemp has been similarly ploughed in, to which has been added a dressing of 480 lbs. of Gypsum per acre. The two plots which received a dressing of Gypsum may be fairly included in the comparison, for no general increase in outturn can be traced to its effect, nor is there any adequate reason for expecting this material to make any difference, unless the soil had been distinctly poor in lime, which it is not.

Column 6 gives the average of these four plots for each year during which the experiments lasted.

Column 7 contains the outturn of the unmanured plot and column 8 shows the difference between the outturn of the unmanured plot and the average of the four plots on which a green crop had been ploughed in. This difference is a gain in every year, but 1892-93, the increase varying from 23 to as much as 1,122 lbs. of wheat per acre.

In the majority of years, however, the increase is much more uniform.

16. At another part of the farm the same method of manuring has been employed, and the results are contained in columns 9, 10, 11, 12 and 13. The experiment on the plot on which green hemp was ploughed in with Gypsum was discontinued after the fourth year. For the period, during which this plot was included, an average of the two is given in column 11.

Column 12 contains the outturns of the unmanured plot and column 13 the increase or decrease.

In one year only was there a decrease.

The land on which this experiment was made is probably much poorer than that on which the other series of plots is situated, and also probably poorer than the land on which the "Standard" and "Duplicate" series of plots are, for whilst the outturn of wheat was fairly uniform on these four plots, it has latterly decreased considerably on the "no manure" plot of this second series (green-manuring).

Concurrently the effect of green-manuring has been enhanced. The increase shown as due to ploughing in a green crop in this second series, is considerably greater than that obtained on the first series, which is made evident by a comparison of the columns 8 and 13, respectively.

Cawnpur green manure.	Green Indigo ploughed in.	Green Indigo ploughed in Gypsum 480 lbs.	Hemp ploughed in.	Hemp ploughed in Gypsum 480 lbs.	Average of columns 2, 3, 4 and 5.	Unmanured.	Increase due to manure.	Hemp ploughed in.	Hemp ploughed in and Gypsum.	Mean of columns 9 and 10.	No manure.	Increase or decrease due to manure.
1	2	3	4	5	6	7	8	9	10	11	12	13
1881-82 ...	...	...	...	...	...	...	...	1,713	2,244	1,978	777	+1,201
1882-83 ...	...	...	...	...	...	...	...	1,619	1,855	1,737	1,198	+539
1883-84 ...	2,358	2,396	...	2,260	2,338	1,515	+813	1,529	1,937	1,733	1,082	+651
1884-85 ...	1,944	2,160	1,399	1,476	1,745	623	+1122	1,377	1,431	1,404	659	+745
1885-86 ...	1,494	1,845	1,138	1,083	1,390	1,367	+23	660	...	...	709	—49
1886-87 ...	1,270	1,597	871	1,319	1,264	847	+417	1,500	...	...	751	+749
1887-88 ...	920	617	907	871	829	786	+143	1,285	...	...	587	+698
1888-89 ...	714	762	1,028	835	835	653	+182	814	...	...	447	+367
1889-90 ...	1,670	1,319	1,972	1,452	1,603	1,464	+139	1,122	...	...	484	+638
1890-91 ...	1,984	1,452	1,125	944	1,376	1,162	+214	1,113	...	...	635	+478
1891-92 ...	1,270	1,367	1,004	1,307	1,237	690	+547	1,125	...	...	345	+780
1892-93 ...	1,573	1,658	1,379	1,295	1,476	1,500	—24	...	...	..	...	...

Experiments made at the Nagpur Farm.

17. As already mentioned, there are three series of plots at this farm on which a green crop, san hemp, *crotolaria juncia*, has been annually ploughed in for a number of years.

The comparative results will be found in Statement VII.

The two series of plots A and C are comparable until 1889-90, when C series ceased. They were not irrigated.

In the case of series B, the treatment of the plots was the same from 1884 and 1885, but different crops occupied the land during the first six years, and it was not until 1890-91 that it was made a permanent experiment on the value of green-manuring *with* irrigation for the wheat crop. There are therefore only three years' results to compare in this case. The statement hardly requires any explanation. For the first six years the average outturn of the two plots in A series and in C series, respectively, on which green san heap was ploughed in, have been compared with the average of the corresponding two unmanured plots.

Column 8 shows the amount of increase or decrease.

Column 9, 10, 11 show the results obtained in the B series. As will be seen from the columns 8 and 11 the results obtained at this farm, which, as already mentioned, is situated on black-soil, are quite discordant, and the only conclusion which may safely be drawn from them is that in the majority of years an increase in the outturn of wheat may be obtained with this method of manuring the land. But, as in the case of the employment of cattle-dung for the wheat crop, so likewise here, very considerable obstacles present themselves to the obtaining of concordant results—chiefly due to constant attacks of rust.

There is a further difficulty, which has been experienced at Nagpur, namely, that it has not always been possible to grow the crop of hemp, owing to want of rain in the second half of the monsoon period, and again, if the winter rains are scanty, the hemp crop does not appear to decompose sufficiently thoroughly to become of service to the plant.

None of these difficulties seem to have been met with at Cawnpur.

Nagpur Green manure.	A Hemped, unirriga-ted.	C Hemped, unirriga-ted.	Avarage of columns 2 & 3.	A un-manured, unirriga-ted.	C un-manured, unirriga-ted.	Average of columns 5 & 6.	Increase or Decrease.	B Hemped.	Nil.	Increase. or Decrease.
1	2	3	4	5	6	7	8	9	10	11
1884-85 ...	940	915	928	1,055	640	847	+81	...	...	...
1885-86 ...	250	228	239	762	700	731	—492	Lin-seed.	...	...
1886-87 ...	1,430	1,208	1,319	1,060	780	920	+399	Wheat.	...	...
1887-88 ..	803	893	848	760	733	746	+102	Lin-seed.	...	...
1888-89 ...	275	255	265	525	195	360	—95	Til.	...	...
1889-90 ...	767	582	674	887	687	787	—113	„	...	...
1890-91 ...	760	...	...	515	...	...	+145	925	802	+123
1891-92 ...	582	...	...	450	...	...	+132	632	642	—10
1892-93 ...	312	...	...	230	...	...	+82	242	200	+42

I have already explained in an earlier paragraph (6) of this note that it does not appear expedient to strike arithmetical means of the results of these experiments and a numerical comparison of the value of cattle-dung and of ploughing a green crop for manure, cannot therefore be given. Looking over the results as exhibited in the statements, it will be seen, however, that the increase due to ploughing in a green crop at Cawnpur and at Nagpur is approximately equivalent to a dressing of about 120 cwts. (6 tons) of cattle-dung per acre.

J. WALTER LEATHER,

September 1894. *Agricultural Chemist to the Govt. of India.*

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on 24 February, 2020

Appendix G to the Report on the Nagpur Experimental Farm in the Central Provinces, for the year 1893-94—*ending* 31*st March* 1894.

	Vide Appendix D of Dr. Voelcker's Report.		(1)	(2)	(3)	(4)
	Dung of Lean cattle.	Dung of Grain-fed bullocks.	Poona Cattle-dung.	Cawnpur Cattle-dung.	Poona Farm-yard manure.	Poona Cattle-dung.
Moisture	19·59	17·86	65·07	70·26	36·19	10·73
(*a*) Organic matter	59·26	61·89	13·67	10·54	25·53	43·10
(*b*) Mineral do.	21·15	20·25	21·26	19·20	38·28	46·17
	100·00	100·00	100·00	100·00	100·00	100·00
(*a*) Containing Nitrogen	1·34	1·08	·483	·258	·853	1·008
(*b*) Do. Phosphoric Acid ...	·47	·54	·124	·156	·149	·290